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A Continuing Bibliography with Indexes

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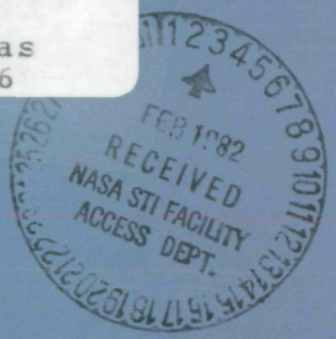

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Accession numbers cited in this Supplement fall within the following ranges.

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IAA (A-10000 Series)	A81-43983 – A81-47132

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NASA SP-7037(142)

AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 142

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in November 1981 in

- *Scientific and Technical Aerospace Reports (STAR)*
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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971. Since that time, monthly supplements have been issued.

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 398 reports, journal articles, and other documents originally announced in November 1981 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* and *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

Three indexes -- subject, personal author, and contract number -- are included.

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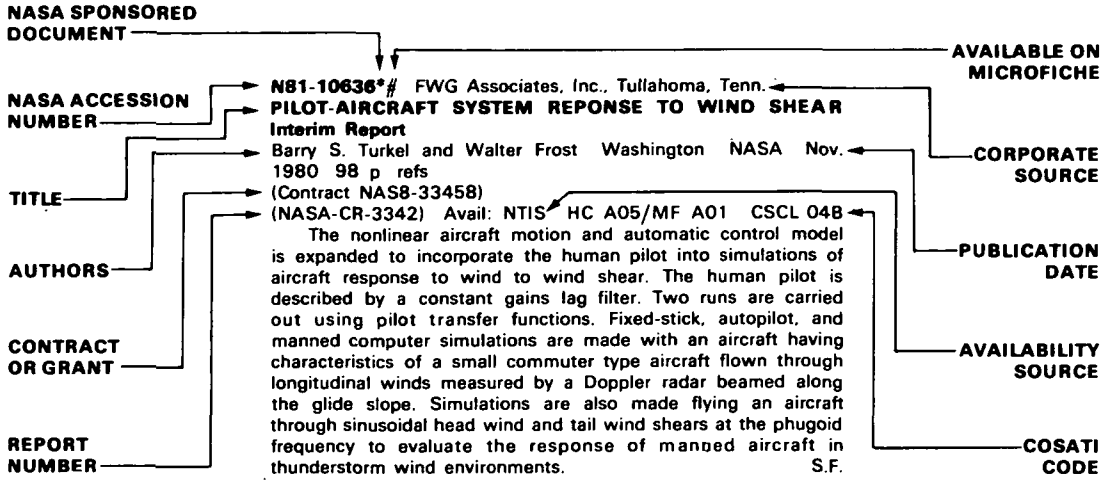

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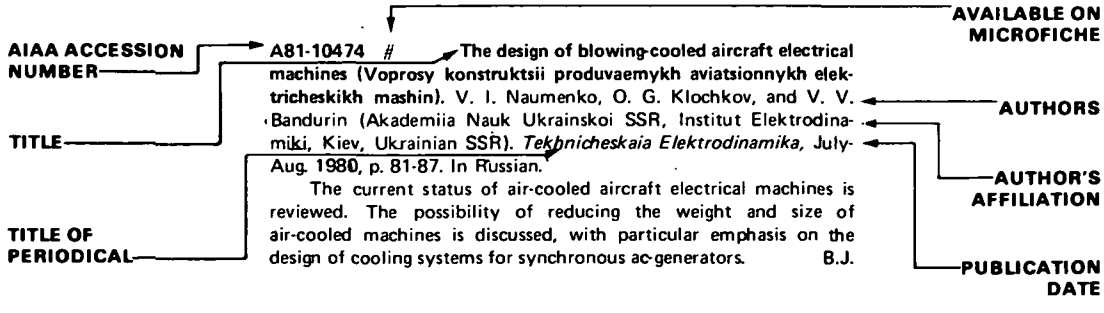

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 142)

DECEMBER 1981

IAA ENTRIES

A81-43998 **Challenges in alloy design - Titanium for the aerospace industry.** D. Banerjee (Defence Metallurgical Research Laboratory, Hyderabad, India) and R. V. Krishnan (National Aeronautical Laboratory, Bangalore, India). *Indian Academy of Sciences, Proceedings (Engineering Sciences),* vol. 4, Apr. 1981, p. 21-39. 30 refs.

This review describes the principles governing the design of titanium alloys for engine and airframe applications in the aeronautical industry. The relationships between processing, microstructure and properties of the commonly used alpha + beta titanium alloys are described in some detail. The state of science is seen to be sufficiently advanced to enable the metallurgist to optimally design this class of alloys to meet specific requirements. The challenges to the alloy designer lie in increasing the temperature capability of titanium alloys, and in standardizing processing techniques which will decrease the high manufacturing costs of components. (Author)

A81-44042 **Boeing 767 - The new fuel saver.** J. Marsden. *Flight International,* vol. 120, Aug. 8, 1981, p. 436-440, 442-448, 453.

A detailed introduction is given for the 767 airliner, which is intended to yield an 8.5% fuel reduction in 100-2000 n. mi. flights by comparison with the A310. Attention is given to such aspects of the aircraft as passenger accommodations, the extensive use of CRT displays for both electronic flight instrumentation and engine indication/crew alerting systems in the cockpit, advanced hydraulic, environmental control and electrical systems, the use of carbon and Kevlar-reinforced plastics, the airframe assembly sequence, and engine performance characteristics. Detailed dimensional data are presented, and a tentative list of airline orders and options is given showing a total of 173 orders and 138 options. Airline orders will differ in their choice of JT9D or CF6-80 engines. A cut-away section of the aircraft is included. O.C.

A81-44043 **Ferranti mission managers.** R. Whitaker. *Flight International,* vol. 120, Aug. 15, 1981, p. 505, 506, 509, 510.

A description is given of the components and functions of a family of advanced inertial navigation/attack mission-management systems for employment in such ground attack aircraft as the Harrier, F-18, Tornado and Jaguar. The systems address problems arising from the need to coordinate terrain avoidance, navigation, target detection, weapon aiming and firing and evasive maneuvers. The following subsystems are incorporated in order to meet the demands of mission management: (1) inertial navigation; (2) a head-down multifunction display comprised of a moving map, sensor inputs and decisionmaking aids; (3) a laser ranger and marked target seeker; and (4) a computer-aided mission planning system with portable data storage. O.C.

A81-44074 **The influence of aircraft operations on air quality at airports.** H. Segal (FAA, Washington, DC) and R. Yamartino (Argonne National Laboratory, Argonne, IL). *Air Pollution Control Association, Journal,* vol. 31, Aug. 1981, p. 846-850. 9 refs. FAA-supported research.

Results are presented of a study of the impact of aircraft emissions on air quality at airports. Air quality data was evaluated through the modeling and monitoring of aircraft emissions at four commercial and one general aviation airport by the statistical analysis of emission plume measurements, the submodeling of aircraft operations at airports, and the construction of Airport Vicinity Air Pollution models for aircraft operations at airports. It is found that the 1-hr average concentrations of CO do not exceed 7 ppm when concentrations are determined under conditions compatible with National Ambient Air Quality standards, which is small compared to the limiting standard of 35 ppm. For NO2, annual average concentrations are found to be 10-20% of the limiting standard, while short-term concentrations represent 30-40% of the WHO health effects limiting level. Peak hourly hydrocarbon concentrations of 5 ppm are modeled. It is concluded that aircraft emissions have a smaller impact on air quality than had been estimated prior to the promulgation of aircraft engine emission standards in 1973. A.L.W.

A81-44076 **Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers.** Conference sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, Inc., 1981. 544 p. Members, $65.; nonmembers, $75.

The subjects considered are related to the effects of convective heat transfer on the performance of inertial systems, the improvement of aircraft specific range by periodic control, fuel optimal aircraft trajectories with fixed arrival times, effects of displacement and rate saturation on the control of statically unstable aircraft, a mode decomposition control logic for system performance enhancement, a fixed-trim re-entry guidance analysis, and maximum information trajectories for homing missiles. Attention is given to differential game guidance laws for intercept missiles, spin-controlled maneuver strategies using unbalanced precessions, synthesizing state-space models to realize given covariance functions, the analysis of aircraft longitudinal handling qualities, autopilot design via improved discrete modal control, adaptive control of flexible space structures, a Doppler aided low accuracy strapdown inertial navigation system, the reality of wheel speed modulation, a Voyager attitude control perspective on fault tolerant systems, the lower limits of seismic background noise levels, implications of improved reliability and maintainability upon digital flight control, and the attitude control of a flexible triangular truss in space. G.R.

A81-44080 # **The improvement of aircraft specific range by periodic control.** E. G. Gilbert (Michigan, University, Ann Arbor, MI) and D. T. Lyons (TRW, Inc., Redondo Beach, CA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 19-27. 21 refs. Grant No. AF-AFOSR-77-3158. (AIAA 81-1748)

The possibility of improving aircraft cruise by periodic motion is investigated for subsonic aircraft with jet engines. A realistic point-mass model is formulated and the potential for improvement in specific range is studied using analytical and computational techniques. The methods of analysis, which are based on special classes of trajectories, give results which support those obtained previously using a less realistic energy-state model. Specifically, significant improvements are possible if a constraint is imposed on the maximum altitude. This conclusion is further substantiated by the computation of optimal periodic trajectories for a wide variety of aircraft characteristics and constraint altitudes. Conditions which favor significant improvement are: large thrust reserve at the constraint altitude, reasonably high lift-to-drag ratio, low constraint altitude, and low wing loading. The trajectory optimization algo-

rithm, which is described in some detail, is especially efficient and may be useful in other applications. (Author)

A81-44081 # **Fuel optimal aircraft trajectories with fixed arrival times.** J. W. Burrows (Boeing Computer Services, Inc., Seattle, WA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 28-34. 7 refs. (AIAA 81-1749)

A maximum principle application shows that a fuel optimal aircraft trajectory which arrives at an assigned time is also a direct operating cost-optimal trajectory for certain time cost. The time cost is minimum for maximum endurance cruise. Only for minimum time cost can an optimal trajectory contain a hold or path stretching segment. These concepts are illustrated for three aircraft: the Boeing 737, 747, and 767. Complete optimal trajectories are shown for the 747. Cruise control implications are investigated using the 767 model. Finally, optimal descents are compared to Mach/CAS descents for the 737. (Author)

A81-44082 * # **Effects of displacement and rate saturation on the control of statically unstable aircraft.** G. D. Hanson and R. F. Stengel (Princeton University, Princeton, NJ). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 35-49. 9 refs. Grant No. NsG-1587. (AIAA 81-1752)

Methodologies are presented for the analysis and design of stability augmentation control laws for aircraft in which 'hard' displacement and rate limiting are significant. Candidate control laws are derived using the linear-quadratic (LQ) regulator. Analytical and computational estimates of the stability limits imposed by control saturation are presented using state trajectories with control limiting, as well as describing functions and eigenvalue computation. Analysis also includes an investigation of the interaction of the state-space saturation and stability boundaries for various choices of LQ weighting matrices. For minimum-energy control, the saturation and stability boundaries are shown to be parallel. In this case, there is a direct relation between the solution to the matrix Riccati equation and the aircraft's open-loop dynamics. (Author)

A81-44083 # **A mode decomposition control logic for system performance enhancement.** M. N. Wagdi (Riyadh, University, Riyadh, Saudi Arabia). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 50-55. (AIAA 81-1753)

The performance of controlled systems is enhanced by treating the system as interconnected subsystems representing different operational modes. Control vectors of one subsystem are preassigned in a feedback form of the states, enabling the specification of eigenvalues and eigenvectors of the subsystem modes. This is considered a prespecified external command input for remaining subsystems, and control vector regulator technique. Emphasis is on constructing a control logic that will optimally control subsystem X while subsystem Y is controlled by an external command input, yielding desired closed-loop eigenvalues. The resulting control strategy is found suboptimal with respect to the overall system, although the system overall performance is improved. D.L.G.

A81-44092 * # **Analysis of aircraft longitudinal handling qualities.** R. A. Hess (NASA, Ames Research Center, Moffett Field, CA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers.
New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 138-145. 11 refs. (AIAA 81-1771)

The optimal control model (OCM) of the human pilot is applied to the study of aircraft handling qualities. Attention is focused primarily on longitudinal tasks. The modeling technique differs from previous applications of the OCM in that considerable effort is expended in simplifying the pilot/vehicle analysis. After briefly reviewing the OCM, a technique for modeling the pilot controlling higher order systems is introduced. Following this, a simple criterion for determining the susceptibility of an aircraft to pilot induced oscillations (PIO) is formulated. Finally, a model-based metric for pilot rating prediction is discussed. The resulting modeling procedure provides a relatively simple, yet unified approach to the study of a variety of handling qualities problems. (Author)

A81-44093 * # **An analytical pilot rating method for highly elastic aircraft.** R. L. Swaim (Oklahoma State University, Stillwater, OK) and S. Poopaka. In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 146-152. 15 refs. Grant No. NsG-4018. (AIAA 81-1772)

An analytical method was developed to predict pilot ratings for highly elastic aircraft subject to severe mode interactions between rigid body and elastic dynamics. An extension of the standard optimal control model of pilot response was made to include the hypothesis that the pilot controls the system with an internal model consisting of the slowly varying part of the aircraft dynamics. This modified optimal control model was analytically evaluated for a longitudinal pitch tracking task on a large flexible aircraft. Parametric variations in the undamped natural frequencies of two symmetric elastic modes were made to induce varying amounts of mode interaction. The model proved successful in discriminating when the pilot can or cannot visually separate rigid from elastic pitch response in the turbulence excited tracking task. This method shows considerable promise in making it possible to investigate such mode interaction effects on handling qualities in the preliminary design stage of new aircraft. (Author)

A81-44094 # **Longitudinal equivalent systems analysis of Navy tactical aircraft.** D. E. Pischoff (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 153-161. 12 refs. (AIAA 81-1775)

The high order transfer functions representing the longitudinal dynamics of augmented aircraft were matched in the frequency domain with first over second order short period models. Matching of the pitch rate to pilot input transfer function is shown to yield excellent time history matches. However, the resulting numerator term (L-alpha) takes on very large, unrealistic values. Two methods are presented for extending the frequency matching technique to restrict the variation of L-alpha. First, the effect of simultaneously matching pitch rate and normal acceleration is demonstrated. Secondly, additional terms are introduced into the pitch rate low order system definition to account for specific control system configurations. A control anticipation parameter is developed which provides correlation between the high and various low order system descriptions. (Author)

A81-44095 # **Autopilot design via improved discrete modal control.** D. V. Stallard (Raytheon Co., Missile Systems Div., Bedford, MA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers.
New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 162-172. 43 refs. (AIAA 81-1777)

The objective is to develop a computationally practical method of applying discrete modal control theory to the design of an improved pitch autopilot of an interceptor missile, with realistic modelling and constraints. A new discrete 'Mode Reckoner' algorithm is described, which can calculate deterministically the modes needed for feedback to achieve the desired eigenvalues; the algorithm also calculates the disturbance moment, which is cancelled by feedback. The six-state missile plant in the simulation has the rigid-body pitch dynamics, the first body-bending mode, actuator dynamics and measurements only from a conventional gyro and accelerometer. The desired step response and suppression of disturbance moment are achieved. (Author)

A81-44096 # **Boost-glide range-optimal guidance.** H. J. Kelley, E. M. Cliff, and F. H. Lutze (Optimization, Inc., Blacksburg, VA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers.
New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 173-176. (AIAA 81-1781)

A simple guidance scheme is proposed which optimizes approximately the range of the glide phase of a boost-glide vehicle's

trajectory. The scheme requires only altitude, flight-path angle, and attitude measurements for implementation. The guidance law provides an attitude command based on the actual flight-path angle and on a calculated flight-path angle associated with that of an equilibrium, constant dynamic pressure, glide of maximum lift-to-drag ratio. By proper weighting of these two inputs, an approximately optimal guidance control is realized. Two examples are given which demonstrate the trajectory characteristics for a high-performance aircraft and for a missile-type vehicle. (Author)

A81-44101 # **Doppler aided low accuracy strapdown inertial navigation system.** I. Y. Bar-Itzhack (Technion - Israel Institute of Technology, Haifa, Israel) and D. Serfaty. In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 206-216. 20 refs. Research supported by the Israel Aircraft Industries, Ltd. (AIAA 81-1798)

This paper presents a covariance analysis of the performance of a Doppler aided low accuracy, coarsely aligned strapdown inertial navigation system (INS) whose fine alignment takes place automatically in flight. It is shown that the fine alignment in azimuth, which requires turns, consists of in-flight gyro calibration and in-flight gyrocompassing. The spacing of the turns is investigated. The influence of several position fixes is examined and it is shown that they can replace INS turns. It is also shown that the use of magnetic heading reference reduces system errors but is not necessary for the satisfactory performance of the augmented system. Two sub-optimal Kalman filters are designed and evaluated. Their small performance degradation with respect to that exhibited by the optimal filter and their low sensitivity to parameter changes is demonstrated by true covariance simulation runs. (Author)

A81-44108 * # **Multiobjective insensitive design of airplane control systems with uncertain parameters.** A. A. Schy (NASA, Langley Research Center, Hampton, VA) and D. P. Giesy (Kentron International, Inc., Hampton, VA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 262-273. 13 refs. (AIAA 81-1818)

A multiobjective computer-aided design algorithm has been developed which minimizes the sensitivity of the design objectives to uncertainties in system parameters. The more important uncertain parameters are described by a gaussian random vector with known covariance matrix, and a vector sensitivity objective function is defined as the probabilities that the design objectives will violate specified requirements constraints. Control system parameters are found which minimize the sensitivity vector in a Pareto-optimal sense, using constrained minimization algorithms. Example results are shown for lateral stability augmentation system (SAS) design for three Shuttle flight conditions. (Author)

A81-44109 * # **Motion-base simulator results of advanced supersonic transport handling qualities with active controls.** J. B. Feather and D. S. Joshi (Douglas Aircraft Co., Long Beach, CA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 274-280. 8 refs. Contract No. NAS1-16147. (AIAA 81-1819)

Handling qualities of the unaugmented advanced supersonic transport (AST) are deficient in the low-speed, landing approach regime. Consequently, improvement in handling with active control augmentation systems has been achieved using implicit model-following techniques. Extensive fixed-based simulator evaluations were used to validate these systems prior to tests with full motion and visual capabilities on a six-axis motion-base simulator (MBS). These tests compared the handling qualities of the unaugmented AST with several augmented configurations to ascertain the effectiveness of these systems. Cooper-Harper ratings, tracking errors, and control activity data from the MBS tests have been analyzed statistically. The results show the fully augmented AST handling qualities have been improved to an acceptable level. (Author)

A81-44110 * # **Investigation of control, display, and crew-loading requirements for helicopter instrument approach.** J. V. Lebacqz, R. M. Gerdes (NASA, Ames Research Center, Moffett Field, CA), R. D. Forrest (FAA, Moffett Field, CA), and R. K. Merrill (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 281-295. 19 refs. (AIAA 81-1820)

A ground simulation experiment was conducted on a flight simulator for advanced aircraft to investigate the influence and interaction of flight-control system, flight-director display, and crew-loading situation on helicopter flying qualities during terminal-area operations in instrument conditions. Six levels of control complexity were implemented on a representative helicopter model. The six levels of augmentation were examined with display variations consisting of raw elevation and azimuth data only and of raw data plus one-, two-, and three-cue flight directors. Crew-loading situations simulated for the control-display combinations were dual-pilot operation and single-pilot operation. Four pilots performed a total of 150 evaluations of combinations of these parameters for a representative microwave landing system approach task. Pilot rating results indicated the existence of a control display trade-off for ratings of satisfactory, whereas ratings of adequate-but-unsatisfactory depended primarily on the control system; the control system required for ratings of adequate-but-unsatisfactory was clearly more complex for the single-pilot situation than that for the dual-pilot situation. (Author)

A81-44111 # **IFFC flying qualities simulation.** T. J. Cord (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 296-300. (AIAA 81-1821)

A piloted simulation of an Integrated Flight/Fire Control (IFFC) automatic tracking system has been performed on the Flight Dynamics Laboratory LAMARS simulation facility. The main objectives were to assess the flying qualities of such a system and to gather information on how the pilot interacts with a high-gain, high-bandwidth automatic guidance system. Results are presented in terms of performance and pilot opinion ratings for aircraft configurations which include variations in visual display (lead-computing optical sight (LCOS), director, fixed sight and IFFC), and flight control system definition (level of IFFC application). (Author)

A81-44122 # **Control characteristics of a Buoyant Quad-Rotor Research Aircraft.** B. L. Nagabhushan, D. W. Lichty, and N. P. Tomlinson (Goodyear Aerospace Corp., Defense Systems Div., Akron, OH). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 370-377. (AIAA 81-1838)

Control characteristics of a Buoyant Quad-Rotor Research Aircraft are predicted by considering such a vehicle configuration based on preliminary design. Concepts for controlling the vehicle with or without its external sling load are evaluated by using a flight dynamics simulation of the configuration. Results are presented which show the vehicle response to control inputs, wind disturbances, and power failure while hovering over a point on the ground. Typical control power and trim characteristics of the vehicle are also discussed. (Author)

A81-44123 # **Modern control synthesis applied to the longitudinal decoupled motion of an aircraft.** J. L. Speyer, J. E. White, and D. G. Hull (Texas, University, Austin, TX). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 378-389. 13 refs. Research supported by the General Dynamics Corp. (AIAA 81-1839)

Multi-input/multi-output control synthesis for the longitudinal decoupled motion of an aircraft is developed using the Linear-Quadratic Gaussian synthesis technique. The objective is to track commands of pitch rate and normal acceleration using the flap and the elevator. A completely controllable state space is developed which determines the structure of the compensator. With this robust compensator, the command is tracked with zero steady-state error. From pitch rate, acceleration and angle of attack measurements, this

state space is reconstructed from an observer. The controller gains are chosen to avoid stimulating the higher-order actuator modes while the observer gains are chosen to enhance robustness. In fact, acceptable, robust performance is obtained with only an acceleration measurement. (Author)

A81-44126 # **Use of atmospheric electric fields for vertical stabilization and terrain avoidance.** M. L. Hill, T. R. Whyte, R. O. Weiss (Johns Hopkins University, Laurel, MD), R. Rubio (U.S. Army, Atmospheric Sciences Laboratory, White Sands Missile Range, NM), and M. Isquierdo (Texas, University, El Paso, TX). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 401-410. 17 refs. Army-supported research. (AIAA 81-1848)

Using a light aircraft and mini-RPVs (remotely piloted vehicles), in-flight measurements of the quasi-electrostatic field which exists in the atmosphere have been made in various weather and terrain conditions. During flight tests of a mini remotely piloted vehicle near an 8000-ft high mountain peak, it was observed that favorable curvatures of the field lines exist and that such a stabilization system can provide for avoidance of collision with such protrusions. The heading of a mini RPV aimed towards the mountain peak was automatically changed to a heading directly away from the mountain by automatic commands generated by an electrostatic stabilization system. Signals in the roll axis loop of the electrostatic system show that in a region about 200 meters in front of a precipitous cliff the equipotential planes were favorably tilted downward to angles as large as 20 degrees. (Author)

A81-44127 * # **Flying qualities criteria and flight control design.** D. T. Berry (NASA, Flight Research Center, Edwards AFB, CA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 411-415. (AIAA 81-1823)

Despite the application of sophisticated design methodology, newly introduced aircraft continue to suffer from basic flying qualities deficiencies. Two recent meetings, the DOD/NASA Workshop on Highly Augmented Aircraft Criteria and the NASA Dryden Flight Research Center/Air Force Flight Test Center/AIAA Pilot Induced Oscillation Workshop, addressed this problem. An overview of these meetings is provided from the point of view of the relationship between flying qualities criteria and flight control system design. Among the items discussed are flying qualities criteria development, the role of simulation, and communication between flying qualities specialists and control system designers. (Author)

A81-44133 # **Closed-loop criteria for assessing longitudinal-axis handling qualities of transports in final approach.** W. H. Levison (Bolt Beranek and Newman, Inc., Cambridge, MA) and W. W. Rickard (Douglas Aircraft Co., Long Beach, CA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 470-479. 12 refs. (AIAA 81-1773)

A methodology is demonstrated for assessing longitudinal-axis handling qualities of transport aircraft on the basis of closed-loop criteria. Six longitudinal-axis approach configurations were studied covering a range of handling quality problems that included the presence of flexible aircraft modes. Using closed-loop performance requirements derived from task analyses and pilot interviews, predictions of performance/workload tradeoffs were obtained using an analytical pilot/vehicle model. A subsequent manned simulation study yielded objective performance measures and Cooper-Harper pilot ratings that were largely consistent with each other and with analytic predictions. (Author)

A81-44134 # **Low-order approaches to high-order systems - Problems and promises.** D. G. Mitchell and R. H. Hoh (Systems Technology, Inc., Hawthorne, CA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 480-490. 18 refs. Contract No. F33615-80-C-3604. (AIAA 81-1774)

Low-order equivalent system approaches to analysis of aircraft pitch dynamics are reviewed. Equivalent systems show promise for reducing the transfer functions of complex, highly-augmented aircraft into familiar and interpretable parameters. The merits of such approaches are discussed in light of the flying qualities military specification and the desire to retain the classical criteria for defining acceptable pitch characteristics. Several potential problems with interpreting the equivalent systems parameters are reviewed. Some high-order transfer functions are shown to produce low-order system parameters which may not be equivalent to their classical counterparts and which may be difficult to physically interpret. (Author)

A81-44135 * # **Flight test results for the F-8 digital fly-by-wire aircraft control sensor analytic redundancy management technique.** J. C. Deckert (Charles Stark Draper Laboratory, Inc., Cambridge, MA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 491-499. 6 refs. Contract No. NAS4-2675. (AIAA 81-1796)

This paper reviews the formulation and flight test results of an algorithm to detect and isolate the first failure of any one of twelve duplex control sensor signals being monitored. The technique uses like-signal differences for fault detection while relying upon analytic redundancy relationships among unlike quantities to isolate the faulty sensor. The fault isolation logic utilizes the modified sequential probability ratio test, which explicitly accommodates the inevitable irreducible low frequency errors present in the analytic redundancy residuals. In addition, the algorithm uses sensor output selftest, which takes advantage of the duplex sensor structure by immediately removing a highly erratic sensor from control calculations and analytic redundancy relationships while awaiting a definitive fault isolation decision via analytic redundancy. This study represents a proof of concept demonstration of a methodology that can be applied to duplex or higher flight control sensor configurations and, in addition, can monitor the health of one simplex signal per analytic redundancy relationship. (Author)

A81-44268 # **The influence of structural parameters and velocity on the shimmy of self-aligned wheels (Vliianie konstruktivnykh parametrov i skorosti dvizheniia na shimmi orientiruiushchikhsia koles).** L. G. Lobas and N. V. Nikitina (Akademiia Nauk Ukrainskoi SSR, Institut Mekhaniki, Kiev, Ukrainian SSR). *Prikladnaia Mekhanika*, vol. 17, July 1981, p. 127-131. In Russian.

An analysis is presented of the integral curves of a dynamic system modeling landing gear with self-aligned wheels. A numerical solution is used to study the effect of structural parameters (e.g., the type of damper, the dry friction moment, and the stiffness of the elastic element of the damper) on the integral curves. B.J.

A81-44299 **New visual displays for the next generation of civil aircraft (Nouvelles visualisations pour la prochaine génération d'avions civils).** J. P. Laborie (Société Nationale Industrielle Aérospatiale, Division Avions, Toulouse, France). *L'Onde Electrique*, vol. 61, June-July 1981, p. 11-16. In French.

Visual display devices based on cathode ray tubes which will be installed on the next generation of civil aircraft are discussed with particular emphasis on those intended for the A 310 and A 300-600 Airbus. The new devices, in contrast to those currently in use to replace classical instrumentation, derive from preliminary definition studies for the redesign of the instrument panel and are destined for use on board civil aircraft currently in the design and preliminary realization stages, including the Boeing 767 and the A 310 Airbus. On the A 310, cathode ray tube applications include the Primary Flight Display, assuming functions of short-term control and medium-term guidance, the Navigation Display, for use in long-term navigation, an alarm display, and a systems display, which indicates the states of aircraft systems. A.L.W.

A81-44322 **The selection of air radio navigation system for the post-1990 period (Le choix du système de radionavigation aérienne pour la période postérieure à 1990).** J. C. Heurtley and J. W. Bradley (FAA, Washington, DC). *(Institute of Electrical and Electronics Engineers, Position Location and Navigation Symposium, Atlantic City, NJ, Dec. 8-11, 1980.) Navigation* (Paris), vol. 29, July 1981, p. 259-266. In French.

The selection by the FAA of the air radio navigation system or

combination of systems best suited to meet the needs of the post-1990 period is discussed. The place of the FAA radio navigation system studies within the Federal Radionavigation Plan is outlined, and the elements of the short-term program undertaken by the FAA for meeting current needs with currently available equipment are indicated. The steps of the long-term planning for the 1990s and beyond are then examined in detail, with attention given to the technical, economic and institutional factors governing the selection of a future navigation system for civil aviation. Means for determining the performances of present systems and future performance in the areas of precision, coverage, reliability and operational value are discussed, and the conformability of the systems currently under consideration, namely VOR/DME, LORAN C and Navstar/GPS, to these criteria is examined. It is pointed out that although the analyses of the FAA will be taken into account in the recommendation of a future system, the final selection is up to the users. A.L.W.

A81-44323 Aerial collisions with relief features (Les collisions aériennes avec le relief). *Navigation* (Paris), vol. 29, July 1981, p. 288-311. In French.

An analysis is presented of characteristics common to jet aircraft collisions with obstacles on the ground. Attention is given to the conditions of visibility, flight control responsibilities, knowledge of the terrain by the crew and predicted flight paths as possible factors contributing to collisions during the approach and landing phases of a flight. It is pointed out that such accidents are usually attributed to the lack of a precise determination of aircraft position and a closer cooperation between the flight commander and the other members of the crew in preparation for descent is recommended. The circumstances of two aircraft accidents classified as relief collisions are related as illustrations of these points. The accidents involved the collision of a SE 210 Caravelle with a hill upon a direct approach to Dubai airport in March, 1972, and the destruction of a B 727 upon approach to Washington Dulles International Airport in December, 1974. A.L.W.

A81-44324 Automated celestial position determination (Le point astronomique automatisé). *Navigation* (Paris), vol. 29, July 1981, p. 341-360. In French.

Methods for the application of microprocessors in celestial position calculations are examined. Following a brief review of transformations of the four triangulation formulas which have been developed to simplify position calculations, the formulas of Guyou (1909), which are readily adaptable to machine calculations, are presented, and the determination of the celestial fix according to these formulas, which allow position determination at an estimated parallel, are analyzed. The application of the method under actual conditions in Cartesian coordinates is considered, with particular attention given to cases of elevation curves of the first, second and third types and culmination near the zenith. A.L.W.

A81-44329 Advanced ultrasonic testing of aerospace structures. R. J. Botsco (NDT Instruments, Inc., Huntington Beach, CA). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 24-33.

Attention is given to two new and very diverse ultrasonic test methods which are especially well suited for inspecting aerospace structures. One method utilizes the ultrasonic impedance plane (BondaScope) for inspecting bonded structures. The other method involves high resolution pulsed ultrasound (NovaScope) which finds particular use for the thickness gaging of critical, complex structures. Actual test results obtained on a wide variety of typical structures are included to demonstrate the capabilities and versatilities of these ultrasonic methods. Applications of the test methods include the detection and depth location of unbonds in multi-layered metal laminates, the detection of unbonds between graphite layers bonded to other types of materials, the testing of Kevlar structures, and the inspection of boron fiber and fiberglass composites. G.R.

A81-44341 Composite applications on Boeing commercial aircraft. V. S. Thompson (Boeing Commercial Airplane Co., Seattle, WA). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 194-201.

An overview is presented of the application of such advanced composite materials as graphite, Kevlar and hybrid Kevlar/graphite-reinforced plastics to the 767/757 series aircraft, based on experience since the early 1960s with fiberglass-reinforced plastics. It is shown that the application of such materials to rudders, elevators, spoilers, ailerons, landing gear doors, fixed trailing edges, fairings and engine cowls represents a weight savings of about 1250 lb by comparison with metallic alternatives. This 25-30% weight reduction factor has been demonstrated to yield annual fuel savings of $750,000 on 747 aircraft. Attention is given the details of manufacturing and their attendant cost savings, such as the 25% reduction in the cost of a 737 aircraft fiberglass rudder panel by comparison to a mechanically fastened aluminum structure. O.C.

A81-44342 EF-111A graphite/epoxy Horizontal Stabilizer Trailing Edge. J. A. Suarez and S. J. Dastin (Grumman Aerospace Corp., Bethpage, NY). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981.

Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 202-215. Contract No. F33615-78-C-5234.

A production-suitable, vacuum-bag-cure manufacturing method for integrally stiffened graphite/epoxy sandwich structure has been verified for the EF-111A Horizontal Stabilizer Trailing Edge. Fabrication and static test of a structurally complete EF-111A Horizontal Stabilizer Trailing Edge has demonstrated the feasibility of constrained, vacuum pressure, oven-processing techniques for single integral cure exact molded (SICEM) assemblies. Cost and producibility analyses have been performed on the integrally-cured trapezoidal stiffener concept to determine production benefits and to project realistic total costs. (Author)

A81-44355 Development and hardware verification of an aeroelastically tailored forward swept composite wing. J. W. Ellis (Rockwell International Corp., North American Aircraft Div., Los Angeles, CA). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981.
Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 362-373.

The development, fabrication and testing of a divergence- and flutter-resistant subscale wing structure, representing a high performance forward-swept fighter wing, are described, with attention to an unorthodox unbalanced laminate composite ply wing skin design that provides special aeroelastic tailoring characteristics. Verification of the design was provided by wind tunnel testing of the 0.6-scale wing model at transonic speeds. Extensive details are given for the construction methods employed in the production of the subscale wing, along with performance-prediction computer studies of the structure. O.C.

A81-44373 Utilization in industry of ICAM 'Manufacturing Cost/Design Guide' /MC/DG/ for composite structures. D. S. Klivans (Rockwell International Corp., Los Angeles, CA) and B. R. Noton (Battelle Columbus Laboratories, Columbus, OH). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 593-600.

Utilizing the MC/DG, trade-studies have been conducted on advanced composite fuselage shear-panels. The configurations included light weight/high complexity; moderate weight/moderate complexity; and high weight/low complexity configurations. The panels were of single curvature and were assembled using mechanical and cocuring methods. The graphite/epoxy selected was AS/3502-6. The configurations studied included hat and J-sections for the stringers, and J-sections for the frames, and the manufacturing man-hours were determined for each. The results are presented in diagrams indicating the weight and manufacturing man-hours for each configuration. The MC/DG formats were used to develop the design employing a step-by-step approach to support the cost of the

concept. The final cost was accurate, and the objectives of the MC/DG program were demonstrated. (Author)

A81-44374 Utilization in industry of ICAM 'Manufacturing Cost/Design Guide' /MC/DG/ for metallic structures. A. J. Pillera (Lockheed-California Co., Burbank, CA) and B. R. Noton (Battelle Columbus Laboratories, Columbus, OH). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 601-606.

The MC/DG has been utilized for structural performance/manufacturing cost studies of seven titanium fuselage panel designs for an SST project. Various structural concepts with varying skin thicknesses, frames, and stringer count, were studied. An engineering team conducting the trade studies, included design, stress, weight, and producibility engineers. Detailed engineering drawings were utilized providing realistic applications of the MC/DG. The study enabled the selection of the most cost-effective concept by determining the cost of weight saved for each panel. The use of the MC/DG was fully demonstrated in developing a cost/weight effective design by utilizing the manufacturing cost methodology developed. This provided program dollar costs (including materials, labor and tooling). (Author)

A81-44375 The ICAM 'Manufacturing Cost/Design Guide' /MC/DG/ for Avionics. R. Remski (Honeywell, Inc., St. Louis Park, MN), J. G. Vecellio (Rockwell International Corp., Avionics and Missiles Group, Cedar Rapids, IA), and B. R. Noton (Battelle Columbus Laboratories, Columbus, OH). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 607-619. USAF-supported research.

General and specific ground rules, which include specifications of electronic discrete parts, materials, assemblies, and manufacturing methods, are described. An overview is given of the aerospace electronic design processes, indicating the way in which the MC/DG will be used to conduct trade studies at the conceptual design phase, as well as the detailed design phases for the circuitry and the chassis. The numerous trade studies and data requirements to achieve affordable performance in avionic systems are surveyed. It is noted that these data must be presented to designers so that the cost-trade studies can be conducted with schedule limitations. C.R.

A81-44378 Future applications of adhesive bonding in the U.S. Air Force. T. J. Reinhart (USAF, Materials Laboratory, Wright-Patterson AFB, OH). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 642-651.

Service experience with structural adhesive bonding on fighter, transport and bomber aircraft is summarized. It is pointed out that bonded construction on the C-5, F-111, and F-15 and the new technology replacement components for the C-130 and C-141 have given outstanding performance. It is thought that the gradual switch to the Boeing-developed phosphoric acid anodize will permit even greater reliability to be built into the adhesive bonded components. Areas in which research is still required are indicated; these include: feed-back control of the cure process, life prediction methdology for adhesive bonded structures, techniques for automated inspection of treated adherend surfaces, and the automated application of the adhesive to the surfaces to be bonded. C.R.

A81-44382 Maintenance and repair of advanced composite structure. C. E. Beck (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 689-694. 8 refs. DOD-USAF-Navy-supported research.

It is shown that graphite/epoxy structures, designed in a variety of configurations and for a wide range of load intensities, can be effectively repaired to virtually full original strength. Among the composites using vehicle types considered are helicopters, space and missile systems, and fixed-wing aircraft, including such advanced military aircraft as the F-14, F-15, F-16, F-18 and AV-8B. Attention is given the portion of life cycle costs represented by structural maintenance and repair. It is shown that total operational and maintenance costs currently far exceed initial acquisition cost. O.C.

A81-44383 Review of Navy composite repair program. A. Manno (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 695-704. 7 refs.

Applications of composite materials to current and near-term Navy aircraft have necessitated the establishment of repair methods both for field and depot maintenance levels. Navy requirements are presented for field level repairs as they apply to current repair programs with emphasis on Navy facilities and capabilities. Repair concepts for damages up to 4 inches in diameter have been developed for field level applications for relatively thick wing skins. Results of this work are presented for both bonded and bolted concepts. Additional work is currently being performed as part of a recently initiated program for field level repairs in which a wide range of thicknesses and damage types is being addressed. A survey of existing materials is being made to select the best materials and processes available to meet the Navy requirements. An extensive test and evaluation program is being performed as part of this program. (Author)

A81-44384 Composite repair concepts for depot level use. J. D. Labor (Northrop Corp., Hawthorne, CA). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 705-715. Contract No. N62269-80-C-0232.

A description is given of a Navy program being conducted to develop and validate repair procedures, at depot-level facilities, for the repair of graphite/epoxy structural components typical of emerging Naval aircraft. The structural configurations considered include: (1) monolithic skin panels up to 0.4 in. thick, (2) full-depth honeycomb sandwich construction, and (3) sine-wave spar or rib substructures. The realistic criteria to be met include the stipulation that autoclaves will not be used, and that repairs be made directly on the aircraft with access limited to one side of the structure. A separate investigation was made of the tendency of a parent laminate, having previously absorbed moisture, to delaminate or blister during the repair cure cycle. The criteria defined include such service requirements as operating temperature range, strength, fatigue loading and environmental exposure. O.C.

A81-44385 Advanced composite repair - Recent developments and some problems. S. H. Myhre (Northrop Corp., Aircraft Div., Hawthorne, CA). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981.

Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 716-727. 18 refs. Contract No. F33615-79-C-3217.

Attention is given to the maintenance and repair of advanced composite materials used in aircraft. The experience gained in the past decade is summarized. Emphasis is given to generic problems rather than to those related to particular types of hardware. Problems discussed include bonding on wet laminates, nondestructive inspection, environmental effects, simplified field repair, and joint repair. It is noted that the development of repair technology throughout the 1970's has demonstrated the repairability of composite structure, as seen in at least five independent investigations. C.R.

A81-44393 Advanced structural repair for lower cost. A. L. Sanders, Jr. (Rockwell International Corp., North American Aircraft Div., Los Angeles, CA) and H. C. Croop (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). In: Material and process applications - Land, sea, air, space; Proceedings of the

Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 804-815. USAF-sponsored research.

The objectives of defense department reliability and maintainability activities are considered. As a contribution to the achievement of these objectives, a study is being conducted regarding the possible applications of newer technologies to reduce structural maintenance costs of in-service Air Force aircraft. The program for the study is structured to be completed in four separate phases. The Phase I objective was to identify chronic high-cost structural maintenance problems of 16 operational Air Force aircraft. The activities of Phase II were related to the selection of a primary repair/replacement candidate, and the development of innovative cost-effective repair solutions or new designs, using advanced materials and/or processes. Phase III is to provide a feasibility demonstration. G.R.

A81-44394 Repair of adhesive bonded structure on commercial aircraft. T. Seidl (United Air Lines, Inc., San Francisco, CA). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 816-824.

Modern aircraft would be inconceivable without structural adhesives. Problems related to maintenance operations and bonding repairs are considered. One of the most common problems associated with bonded parts is their propensity to absorb water. The presence of water may be inferred if the unit weight has increased over a previously established weight, or it may be verified by an X-ray examination or, in the case of nonmetallic structure, by means of a moisture detector. Delaminations, often directly resulting from ingested water, may be identified by coin-tapping. Attention is given to physical damage, delaminations, corrosion removal, liquid removal, the replacement of structural members, the replacement of face sheets and core in nonmetallics, and the replacements of face sheets, doublers, and core materials. Finishes and sealants are discussed, taking into account polyurethane enamel, polysulfide sealants, and silicone sealants. It is pointed out that major repairs to bonded structure are impossible without proper fixtures, contour molds, and honeycomb cutters. G.R.

A81-44395 Development of large-area damage repair procedures for the F-14A horizontal stabilizer. Phase I - Repair development. J. Mahon (Grumman Aerospace Corp., Bethpage, NY) and J. Candella (U.S. Navy, Norfolk, VA). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 825-835.

Many F-14A aircraft have been in active service for several years and, as a result, a number of the aircraft have sustained damage to the boron/epoxy stabilizer. Much of this damage has been less than 2-in. in diameter and was effectively repaired. The damage to the horizontal stabilizers of some aircraft, however, has been far more extensive, approaching 6-in. in diameter. The Large-Area Repair Program was initiated to develop structural repairs for damage up to 6 in. in diameter to the F-14 horizontal stabilizer boron/epoxy covers. The repair approach involves application of an autoclave cocured, adhesive bonded, boron/epoxy flush patch to the damage site. The Large-Area Repair Program is divided into four phases. A description is presented of the technical results of the Phase I effort. During Phase I, the large-area repair was developed and verified by the successful static testing of three unconditioned, damaged, and repaired test elements at ambient and elevated temperatures. G.R.

A81-44396 Nonhoneycomb composite skin stabilization - A solution to high costs of maintenance. R. L. Miller and W. C. Cooper (Vought Corp., Dallas, TX). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 836-847. Contracts No. F33615-78-C-5108; No. F34601-77-A-0176-SA47.

Problems with adhesively bonded metallic honeycomb sandwich structures are related to corrosion and debonding of metallic sandwich structures leading to excessive inspection, maintenance, and replacement costs. The operating costs attributed to deficiencies in metallic honeycomb structures have been, and continue to be of serious concern. An investigation was conducted with the objective to find a solution to these problems. The conclusion was reached that nonhoneycomb skin stabilized composite structures are a viable alternative to the continued high maintenance cost of many metallic honeycomb structures. The considered composite articles are direct replacements for their metallic counterparts. The composite structures can be produced cost-competitively. Nonautoclave processing methods are applicable to this type of structure. Life cycle projections indicate a significant reduction in cost through lower replacement rates and less frequent and less complex inspection requirements. G.R.

A81-44398 Skin-stabilized horizontal stabilizer for the T-38 aircraft. D. L. Stansbarger (Northrop Corp., Aircraft Div., Hawthorne, CA). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 861-873. USAF-sponsored research.

Under an on-going program sponsored by the Air Force Materials Laboratory, Manufacturing Technology Division, Northrop Corporation is developing an innovative manufacturing/design approach to the production of advanced composite empennage structures which utilize skin stiffened stabilization techniques in lieu of full depth honeycomb core. This technology will allow a direct replacement to be made for existing metallic honeycomb assemblies, resulting in a reduction in the current high maintenance cost (life cycle cost) associated with existing metallic honeycomb sandwich structures due to corrosion and water entrapment, as well as improving the durability and maintainability of the resulting structures. (Author)

A81-44424 * # Effect of leading-edge vortex flaps on aerodynamic performance of delta wings. C. S. Reddy (Old Dominion University, Norfolk, VA). *Journal of Aircraft*, vol. 18, Sept. 1981, p. 796-798. 8 refs. Grant No. NsG-1561.

The effect of leading-edge vortex flaps on the aerodynamic characteristics of highly swept-back wings is analytically investigated, using the free vortex sheet method. The method, based on a three-dimensional inviscid flow model, is an advanced panel type employing quadratic doublet distributions to represent the wing surface, rolled-up vortex sheet and wake and is capable of computing forces, moments and surface pressures. O.C.

A81-44447 # Transonic dip mechanism of flutter of a sweptback wing. II. K. Isogai (National Aerospace Laboratory, Tokyo, Japan). *AIAA Journal*, vol. 19, Sept. 1981, p. 1240-1242.

Possible mechanisms of the transonic dip phenomenon of sweptback wing flutter are investigated. A flutter analysis is performed using a two-dimensional wing having vibrational characteristics similar to a typical streamwise section of a sweptback wing, and a computer code is developed to solve the transonic small perturbation equation by a finite-difference method. The large negative peak value of the out-of-phase component in the load distribution at 0.825 is found to be due to the phase lag of the shock-wave motion, and it is concluded that the shock wave, especially in the phase delay of the shock-wave motion, plays the dominant role in the transonic-dip mechanism. D.L.G.

A81-44471 Mi-26 - The first true heavy lift helicopter. M. Lambert. *Interavia*, vol. 36, Aug. 1981, p. 764-767.

The Soviet helicopter Mi-26 can carry a 20,000 kg payload for a distance of 800 km. Its compact titanium rotor head is the first in the world to carry eight blades. Electric blade deicing is installed. The rotor diameter is 3 meters. Maximum use was made of airfoils to achieve a 50% payload to gross weight ratio. The Mi-26 is suited for operations in Siberia where the climate makes it almost impossible to maintain good roads, and heavy machinery and vehicles have to be moved by air. The cruising speed of the helicopter is 255 km/h. The Mi-26 is flown by a four-man crew, including two pilots, a navigator, and a flight engineer. All four crewmen have large domed windows which offer the only downward and rearward view. Aft of the big

flight deck is a four-seat passenger compartment, and there are about 36 folding seats along the walls of the main cabin. G.R.

A81-44473 The new generation of turboshaft and turboprop engines. M. Grangier. *Interavia,* vol. 36, Aug. 1981, p. 771, 772.

General activities regarding the development of new turboprop and turboshaft engines are currently at a high level in connection with increasing demands for business aircraft, commuter airliners, and helicopters, and also as a result of requirements for more efficient and economical engines. The new engines which are and have recently been developed by aerospace manufacturers in the Western World are considered. Attention is given to the development of a small turbine designed to be manufactured in both turboshaft and turboprop versions, turboshaft engines installed in Lynx helicopters operating with several navies and air forces, engines intended to power new-generation European helicopters with gross weights between 7 and 14 tons, and an engine specifically developed to power a Franco-German anti-tank helicopter. G.R.

A81-44474 The 146 emerges from the shadows. B. Rek and D. Wood. *Interavia,* vol. 36, Aug. 1981, p. 786-788.

The emergence of the British Aerospace 146 airliner came nearly eighteen years after the appearance of the last new British jet airliner, the BAC One-Eleven. The project concerning the new aircraft was adopted in the early 1970s, only to be shelved in 1974 in the wake of the first Arab oil crisis. The 146 airframe is the subject of an extensive work- and risk-sharing program. The reasons for the slow sales progress are considered, taking into account the second fuel-price explosion and accompanying airline recession in 1979, and the remarkable transformation occurring this summer in the fortunes of the 146. There is now a unique product in the shape of the 146-200: a new 100-plus-seat jet airliner powered by fuel-efficient high-bypass-ratio turbofans. G.R.

A81-44554 * # Kinematic properties of rotary-wing and fixed-wing aircraft in steady coordinated high-g turns. R. T. N. Chen (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1855.* 15 p. 24 refs.

An analytical approach to the study of flight dynamics of aircraft operating in a high-angle-of-attack flight regime and of helicopters operating in extreme thrust conditions is presented. Steady coordinated high-g turns are used to establish the initial equilibrium flight conditions near stall angles of attack. The kinematic properties of the aircraft in steady coordinated turns are examined: in high-g turns, pitch rate (independent of the angle of attack) is of a much larger magnitude than roll and yaw rate; a substantial roll rate is found to develop in steep turns for all angles of attack; the angle of attack also has a significant effect on the pitch attitude, with decreasing influence as the normal load factor increases. The exact small disturbance equations of motion of the aircraft in general steady turns are also developed for application to both rotary-wing and fixed-wing aircraft in extreme conditions. These equations are in a first-order, vector-matrix format, and are thus compatible with many efficient software packages developed in modern system theory. J.F.

A81-44556 * # Automatic helical rotorcraft descent and landing using a Microwave Landing System. L. A. McGee, J. D. Foster, and G. Xenakis (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1857.* 11 p. 5 refs.

A helical-approach concept is presented for Instrument Flight Rules (IFR) operation of rotorcraft into congested terminal areas where separation from high-speed jet traffic is highly desirable and the airport-precision-approach aid is a Microwave Landing System (MLS). The concept takes advantage of the fact that rotorcraft need not land on the main runway but can operate from a pad that lies on an MLS radial offset from the centerline. The results of 48 flights using a UH-1H helicopter and a research avionics system are presented. Three levels of navigation sophistication were also investigated. It is shown that an approach helix can be contained in a relatively small volume and that being within the Instrument Landing System (ILS) Category II window at a 30-m (100-ft) altitude is not a requirement for a successful hover over a landing pad. Only two of the three navigation systems provided estimates that allowed all flights to descend from hover to touchdown. (Author)

A81-44557 # Equivalent system analysis of translation rate command systems for hover and low speed flight. C. G. Carpenter and J. Hodgkinson (McDonnell Aircraft Co., St. Louis, MO). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1858.* 10 p. 6 refs.

A fixed-base handling qualities simulation was performed to investigate the characteristics of translation rate command systems in hover and low speed flight. Three types of translation rate command systems were investigated: (1) translation rate generated by attitude, (2) translation rate generated by direct force control and (3) translation rate generated by blended attitude/direct force control. The mission duplicated visual ship-board operation. The high order dynamics were analytically matched by equivalent low order systems, whose parameters were then used to evaluate flying qualities criteria. Pilot comments indicate a preference for a direct force control system. (Author)

A81-44561 # Data analysis for aircraft parameter estimates. W. R. Wells (Wright State University, Dayton, OH) and S. S. Banda (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1864.* 6 p. 8 refs.

Estimates of lateral stability and control derivatives of a single engine general aviation aircraft were obtained from a maximum likelihood estimation algorithm expressed in the frequency domain. The aircraft lateral equations of motion included some of the effects of unsteady aerodynamics. Measured data of the aircraft motion are converted into the frequency domain by a discrete form of the fast Fourier transform algorithm for use in the estimates. The sampling and packing theorems from discrete Fourier transform theory are used to reconstruct intermediate values of the sparsely sampled frequency data. Improvements in the estimates of the stability and control derivatives are noted whenever the interpolation schemes are included in the estimation algorithm. (Author)

A81-44562 * # Determination of model structure and parameters of an airplane from pre- and post-stall flight data. V. Klein (Joint Institute for Advancement of Flight Sciences, Hampton, VA), J. G. Batterson, and P. C. Murphy (NASA, Langley Research Center, Hampton, VA). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1866.* 11 p. 8 refs.

A procedure for airplane model structure determination from flight data based on modified stepwise regression (MSR), several decision criteria and postulated aerodynamic model equations is presented. The MSR is constructed to force a linear model for the aerodynamic coefficient first, then select significant nonlinear terms and reject nonsignificant terms from the model. In addition to the statistical criteria in the stepwise regression, the prediction sum of squares (PRESS) criterion and analysis of residuals are examined for the selection of an adequate model. The procedure is used in examples with simulated and real flight data. It is shown that the MSR performs better than the ordinary stepwise regression and that the technique can be also applied to the large amplitude maneuvers. (Author)

A81-44563 # A model-following technique for insensitive aircraft control systems. G. C. Nield (U.S. Air Force Academy, Colorado Springs, CO) and J. D. Powell (Stanford University, Stanford, CA). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1867.* 10 p. 11 refs.

A new control-system design method is presented which uses model following and full-state feedback to keep the dominant roots of a system constant. Under favorable circumstances, it can accomplish this even in the presence of arbitrarily large parameter uncertainties. The method has the attractive feature that the parameter-insensitivity and disturbance-rejection characteristics of the system can be selected independently from the no-disturbance,

nominal-plant performance. Application is made to an aircraft flight control problem. (Author)

A81-44570 * # **A vortex-lattice method for calculating longitudinal dynamic stability derivatives of oscillating delta wings.** D. Levin (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1876.* 11 p. 23 refs.

A nonsteady vortex-lattice method is introduced for predicting the dynamic stability derivatives of a delta wing undergoing an oscillatory motion. The analysis is applied to several types of small oscillations in pitch. The angle of attack varied between + or - 1 deg, with the mean held at 0 deg when the flow was assumed to be attached and between + or - 1 deg and the mean held at 15 deg when both leading-edge separation and wake roll-up were included. The computed results for damping in pitch are compared with several other methods and with experiments, and are found to be consistent and in good agreement. (Author)

A81-44576 # **Stability characteristics of a forward swept wing aircraft at high angles of attack.** R. A. Calico, Jr. (USAF, Institute of Technology, Wright-Patterson AFB, OH) and S. G. Fuller (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1884.* 8 p. 7 refs.

The stability of an aircraft with a swept forward wing at high angles of attack and sideslip is determined analytically via two methods. The first of these considers an eigenvalue analysis of high angle of attack and sideslip trim conditions, and an alpha, beta stability envelope is determined. These results are compared with an approximate analysis which uncouples the translation and rotational motion of the aircraft and analyzes the stability of the latter. This method only requires the knowledge of static derivatives. This second approach reduces to the familiar, dynamic sideslip angle dimensionless yawing moment coefficient criteria for symmetric flight. The results of the two methods are shown to yield good agreement. (Author)

A81-44577 # **Stability of aircraft motion in critical cases.** J. E. Cochran, Jr. and C.-S. Ho (Auburn University, Auburn, AL). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1885.* 10 p. 9 refs. Research supported by Auburn University.

Methods developed by Malkin (1959) and Liapunov (1950) for the analysis of critical equilibrium states of autonomous nonlinear dynamic systems have been described. The critical states considered are those in which either a single zero eigenvalue or a pair of imaginary eigenvalues of the associated linear system exist and the remaining eigenvalues have negative real parts. Application of the method results in either a single nonlinear, autonomous, ordinary, differential equation, or a pair of such equations, describing motion in the 'critical mode'. Two methods are also used to determine the stability of the motion of a rapidly rolling aircraft in the critical case of one zero eigenvalue and of an aircraft flying at a relatively high angle of attack when the associated linear system has a pair of pure imaginary eigenvalues. J.F.

A81-44578 # **Time-constrained maximum-energy turns.** S. R. Petersen (USAF, Space Div., Los Angeles Air Force Station, CA) and C. E. Rader (USAF, Institute of Technology, Wright-Patterson AFB, OH). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1886.* 10 p. 6 refs.

The object of this study is to find the trajectories which a high-performance aircraft would employ to maximize the change in specific energy during a turn. The turn is through 180 degrees and begins from two different velocities, one above and one below the corner velocity. The turning time is varied over three values in order to examine the effect of additional time on the final specific energy. The values of the change in specific energy during the turns are compared to the changes in specific energy which result from a minimum time turn. A suboptimal control approach, which uses both gradient and second-order parameter optimization techniques, is employed to find the maximum specific energy trajectories. The results show that turning times slightly greater than the minimum turning time allow large increases in aircraft specific energy, and that the trajectories can be flown with simple control inputs. (Author)

A81-44579 # **Lateral-directional flying qualities of transport aircraft.** D. S. Joshi and W. W. Rickard (Douglas Aircraft Co., Long Beach, CA). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1887.* 9 p. 10 refs.

A piloted motion-base simulation test was conducted to evaluate several MIL-F-8785B and -8785C lateral-directional flying qualities criteria. Twenty-seven transport aircraft configurations were designed to span the spectrum of a number of lateral-direction parameters. The experiment was designed to study the effect of each criterion separately. Subjective and objective measures of flying qualities were analyzed using a combination of statistical and graphical methods. Several deficiencies in the criteria were identified and revisions have been proposed. (Author)

A81-44580 # **A unifying framework for longitudinal flying qualities criteria.** R. F. Stengel (Princeton University, Princeton, NJ). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1889.* 13 p. 11 refs. Contract No. N62269-80-C-0720.

The objective of this paper is to interpret existing flying qualities criteria in a multivariable format based upon state vectors and matrices of stability and control derivatives. State-space methods are shown to be entirely compatible with conventional flying qualities analysis. Furthermore, they lead to a new definition of the well-known control anticipation parameter that has potential utility in the evaluation of higher-order aircraft/control systems. (Author)

A81-44581 # **An investigation of the impact of aerodynamic lags on dynamic flight characteristics.** R. W. Thomas (McDonnell Aircraft Co., St. Louis, MO). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1892.* 9 p.

Investigations of an F-15 longitudinal response discrepancy have found evidence of aerodynamic lags influencing conventional dynamic flight characteristics. Lags in an oscillating airfoil and the lift response of the horizontal tails were included in the F-15 aerodynamic math model, reducing short-period damping and resulting in better agreement with flight test data. Effects of aerodynamic lags on the dynamic characteristics of a statically unstable configuration were also investigated. The primary effect was found to be a small decrease in the short period damping, with a larger decrease found with an unstable static margin. Results indicate the potential requirement to include unsteady aerodynamic effects in conventional handling qualities analyses, with emphasis on control system design to assure satisfactory flying qualities. D.L.G.

A81-44615 # **Pressure fluctuations on the surface of a small passenger aircraft. I - Periodic disturbances caused by the rotation of the propeller (Fluktuace tlaku na povrchu maleho dopravniho letounu. I - Periodicke rozruchy vyvolane rotaci vrtule).** Z. Hujecek. *Zpravodaj VZLU,* no. 1, 1981, p. 7-20. 19 refs. In Czech.

The level of internal noise in small passenger aircraft depends on the magnitude of pressure fluctuations on the external surface and the acoustic properties of the fuselage wall. In order to determine the optimal design of the fuselage wall from the viewpoint of acoustic properties, it is necessary to know the pressure fluctuation field on the fuselage surface. For the case of a small turboprop aircraft, the changing pressure fluctuation field is determined by the superposition of the acoustic field caused by the rotating propeller, the pressure fluctuation field caused by the boundary layer on the fuselage wall, the pressure fluctuation field caused by vortices behind the propeller, the effect of flow separation behind irregularities of the surface, and the noise of the engine proper. The present study gives particular attention to periodic disturbances caused by the rotation of the propeller. B.J.

A81-44616 # **Philosophy of safety and reliability (Filozofie bezpecnosti a spolehlivosti).** V. Kahanek. *Zpravodaj VZLU,* no. 1, 1981, p. 21-29. 13 refs. In Czech.

The philosophy of modern approaches to reliability and safety

in aviation is discussed. Statistical data on aircraft accidents are analyzed, and differences in assumptions used for solving problems of reliability and safety are considered. Specific differences between small and large passenger aircraft from the point of view of accident investigation are described. Two tasks directed at the improvement of aircraft reliability and safety are examined: improvement of human factors engineering and the design of fail-safe structures. B.J.

A81-44618 # Pressure fluctuations on the surface of a small passenger aircraft. II - The effect of the turbulent boundary layer (Fluktuace tlaku na povrchu maleho dopravniho letounu. II - Vliv turbulentni mezni vrstvy). Z. Hujecek. *Zpravodaj VZLU*, no. 2, 1981, p. 63-72. 24 refs. In Czech.

In order to determine the optimal acoustic design of the fuselage wall of a small passenger aircraft, it is necessary to know the pressure fluctuation field on the fuselage surface. For the case of a small turboprop aircraft, the changing pressure fluctuation field is determined by the superposition of the acoustic field caused by the rotating propeller, the pressure fluctuation field caused by the boundary layer on the fuselage wall, and other factors. The present investigation examines the role of the turbulent boundary layer in the generation of pressure fluctuations. B.J.

A81-44623 A 7.5 GHz microstrip phased array for aircraft-to-satellite communication. F. W. Cipolla (Ball Corp., Ball Aerospace Systems Div., Boulder, CO). *Microwave Journal*, vol. 24, Aug. 1981, p. 75-78. Contract No. F30602-78-C-0329.

A 7.5 GHz receive-only microstrip phased array, which achieves a gain of 19.8 dBic for the broadside beam, has been developed for the SHF SATCOM communications systems. The device is left-hand circularly polarized and has 3-bit digital PIN diode phase shifters for steering the beam. A microprocessor-based beam steering controller is provided for calculating the phase shifter settings for each beam position. The entire array, including radiating elements, quadrature hybrid, phase shifters, corporate feed, RF chokes, and dc bias, is in microstrip medium. V.L.

A81-44648 * Clear air turbulence - An airborne alert system. L. P. Stearns, F. Caracena (NOAA, Environmental Research Laboratories, Boulder, CO), P. M. Kuhn (Northrop Services, Inc., Moffett Field, CA), and R. L. Kurkowski (NASA, Ames Research Center, Flight Systems Research Div., Moffett Field, CA). *Science*, vol. 213, Aug. 28, 1981, p. 1007, 1008. 5 refs.

An infrared radiometer system has been developed that can alert a pilot of an aircraft 2 to 9 minutes in advance of an encounter with clear air turbulence. The time between the warning and the clear air turbulence event varies with the flight altitude of the aircraft. In turbulence-free areas, the incidence of false alarms is found to be less than one in 3.4 hours of flight time compared to less than one per 10 hours of flight time in areas with turbulence. (Author)

A81-44666 * # Autoignition characteristics of aircraft-type fuels. L. J. Spadaccini and J. A. TeVelde (United Technologies Research Center, East Hartford, CT). *Combustion Institute, Spring Technical Meeting, Warren, MI, Mar. 23, 1981, Paper.* 27 p. 19 refs. Contract No. NAS3-20066.

An investigation was conducted of the ignition delay characteristics of five liquid hydrocarbon fuels in air. The test apparatus developed permitted independent variation and control of temperature, pressure, air flow rate, and fuel/air ratio in order that the effects of each parameter could be investigated independently. All of the fuels tested behaved in a predictable manner, that is, ignition delay time decreased as temperature, pressure, and fuel/air ratio increased. The results for the different fuels tested (Jet-A, MP-4, No. 2 diesel, ERBS, and cetane) were directly comparable, since it can be shown that the fuel spray characteristics from the multiple conical tube injector are relatively insensitive to small changes in fuel properties (viscosity, surface tension, and density). G.R.

A81-44681 Three edge-point estimation schemes for tracking airborne targets. R. J. Machuzak, E. R. Graf, C. L. Phillips, and S. A. Starks (Auburn University, Auburn, AL). In: SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 37-41.

An optimal target centroid estimator is essential to the performance of any sequential-lobing tracking radar. The considered investigation is concerned with a comparative analysis of three edge-point thresholding estimation techniques to determine the most accurate target centroid location estimator within a given set of operating parameters. This analysis was conducted using a software simulation of an automatic landing system which is capable of controlling the variation of certain parameters for the purpose of error isolation. Included in the comparison is an amplitude-weighted scan angle nonthresholding estimator to provide a contrast in the implementation and results of the techniques. It was found that the accuracy of all four estimators increased with the amount of information to be evaluated. The effect of turbulence alone was slight on the accuracy of the estimators. G.R.

A81-44699 An aircraft landing system employing observers. R. F. Wilson, C. L. Phillips, E. R. Graf, and S. A. Starks (Auburn University, Auburn, AL). In: SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 280-284. 5 refs.

Preliminary results are presented of the effort to design an observer to estimate position and velocity for a proportional plus integral plus derivative (PID) controller. Here, the observer is used to reduce noise problems in the control system, which is an automatic aircraft landing system. It is shown that the noise problems are reduced and that adequate stability margins are maintained. The necessity of future work in order to determine the best pole locations for the observer is stressed. C.R.

A81-44700 Image processing design for autonomous acquisition of targets. W. W. Boyd, C. A. MacPherson, J. L. Taylor, J. M. Taskett, and M. C. Lineberry (Texas Instruments, Inc., Dallas, TX). In: SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 285-290.

Primary considerations in designing an image-processing system that can autonomously acquire high-value tactical targets are discussed. Attention is given to establishing requirements, and the implications of these requirements on the image-processing algorithms are analyzed. It is pointed out that through these steps, detection and acquisition times can be estimated and, hence, algorithm processing times established. The results of certain candidate algorithms that show promise of meeting mission goals are presented. The design process described takes account of the geographical and climatological features of the area of intended use. Aircraft maneuverability and human factor limits are also considered in establishing system requirements. Analysis shows the feasibility and desirability of employing the seeker and terrain features to cue the aircraft to the target. C.R.

A81-44741 A comparison of actual and simulated horizontal flight paths - RNAV /Area Navigation/ system. A. Hargrove (Tuskegee Institute, Tuskegee, AL). In: SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 638-642.

The Area Navigation (RNAV) System for aircraft now under development has unique capabilities. Foremost among these capabilities is an Automatic Guidance System which defines great circle flight paths and guides the aircraft along circular transitions at waypoints between these great circle paths. Control laws and philosophies have been developed that will enable the sensors, navigation computer unit and electronic displays of the RNAV system to compute and display current 'real world' positions and path of the aircraft. Simulation of a point mass aircraft model and the actual aircraft configuration is described. (Author)

A81-44849 # Aeronautical engineering - A historical perspective. J. D. Anderson, Jr. (Maryland, University, College Park, MD). *AIAA Student Journal*, vol. 19, Summer 1981, p. 22-31. 11 refs.

Early concepts concerning mechanical, heavier-than-air designs for achieving flight were generally based on an imitation of the flight

of birds. The concept of the modern aircraft with its fixed wings, a fuselage, and a tail was invented by an English baron, George Cayley. After inscribing his idea on a silver disk in 1799, Cayley conducted aerodynamic research related to his invention during a 10-yr period and wrote three research papers. The further evolution of Cayley's idea is discussed, taking into account Henson's design for a fixed-wing aircraft powered by a steam engine driving two propellers, the first powered takeoff by a piloted full-sized aircraft achieved by Du Temple in 1874, contributions made by Lilienthal, the first successful flight of a heavier-than-air powered aircraft in history achieved by Langley, and the developments leading to the first powered, manned flight by the Wrights. G.R.

A81-44850 # **Project Bandit - An economical, high performance business aircraft for the 1990s.** *AIAA Student Journal,* vol. 19, Summer 1981, p. 36-42. 7 refs.

The considered project tries to satisfy the need for a single-engine jet aircraft for fast, long-range business trips. Bandit is a fast and economic jet aircraft and, compared to most existing aircraft, yields significantly higher seat-miles per gallon (88.1 seat-miles/gallon compared to 6-10 seat-miles/gallon for typical present-day general-aviation jet aircraft). Aspects of design philosophy and configuration selection are considered, taking into account the preliminary configurations investigated, a comparison of the Bandit with other aircraft, the fuselage structure of Bandit, the radome, mission-phase fuel weights, the canopy of laminated polycarbonate, the three fuel tanks, the turbofan engine design, the control systems, and performance data. G.R.

A81-44898 * # **Numerical and classical analysis of V/STOL aircraft using selected propulsion systems.** S. B. Wilson, III, G. H. Kidwell, Jr., and R. S. Christiansen (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1676.* 9 p. 17 refs.

The development needed for the evolution of selected V/STOL research vehicles into optimized antisubmarine warfare (ASW) aircraft configurations, using numerical procedures and traditional analytical methods, has been examined. Three propulsion systems, which represent state-of-the-art development aimed at solving the thrust-vectoring and attitude-control problems of V/STOL aircraft, are analyzed. The use of NASA computer programs for aircraft synthesis (ACSYNT), and for optimizing configurations (COMMIN), coupled with contractor-supplied propulsion system data provides for accurate performance prediction of the selected ASW configurations. Particular emphasis on the transition phase between the research vehicle and the optimized configuration demonstrates the strengths and weaknesses of using generic research aircraft instead of building prototypes to demonstrate new technology. (Author)

A81-44899 # **Aerodynamic integration of externally mounted engines on a long-range bomber.** A. E. Schoenheit and W. J. Karger (Rockwell International Corp., North American Aircraft Div., Los Angeles, CA). *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1693.* 9 p.

The B-1 strategic bomber was designed as a multimission variable-sweep weapon system. The diverse aerodynamic requirements of integrating the propulsion system into both an efficient subsonic cruising vehicle and a penetrating subsonic and supersonic weapon system have been achieved. The design process included numerous wind tunnel tests to refine the engine inlet and nozzle characteristics as well as integration of the nacelle package into the overall configuration. The performance bookkeeping process withstood the development obstacles enountered, and the aerodynamic performance levels were substantiated by flight testing. Results are presented which can be useful in future design procedures. (Author)

A81-45315 # **Self-oscillations of a self-aligned landing gear strut in the case of classical nonholonomic rolling constraints (Avtokolebaniia orientiruiushcheisia stoiki shassi v sluchae realizatsii klassicheskikh negolonomnykh sviazei kacheniia).** L. G. Lobas (Akademiia Nauk Ukrainskoi SSR, Institut Mekhaniki, Kiev, Ukrainian SSR). *Matematicheskaia Fizika,* no. 29, 1981, p. 48-55. In Russian.

The derivative-expansion method is used to determine the limit-cycle self-oscillation amplitude for a self-aligned landing gear strut under classical nonholonomic rolling constraints. Recommendations are made on the choice of a damping factor for a square-law damper connected in parallel to the elastic element. The velocity dependences of self-oscillation amplitude and frequency are examined. B.J.

A81-45515 * **Practical solutions to the aircraft minimum fuel, fixed-range, fixed time-of-arrival trajectory optimization problem.** J. A. Sorensen and M. H. Waters (Analytical Mechanics Associates, Inc., Mountain View, CA). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 3 p. (WA10-D). 7 refs. Contract No. NAS1-15497.

A practical scheme is presented for generating fixed range, minimum fuel vertical flight profiles that also satisfy time-of-arrival constraints. The resulting algorithm is suitable for incorporation into an on-board flight management system. Example results show that such a capability can save up to 6% of fuel burned in flights subject to delays because of terminal area congestion. (Author)

A81-45518 * **Pareto-optimal multi-objective design of airplane control systems.** A. A. Schy, K. G. Johnson (NASA, Langley Research Center, Hampton, VA), and D. P. Giesy (Kentron International, Inc., Hampton, VA). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 8 p. (WP1-A). 10 refs.

A constrained minimization algorithm for the computer aided design of airplane control systems to meet many requirements over a set of flight conditions is generalized using the concept of Pareto-optimization. The new algorithm yields solutions on the boundary of the achievable domain in objective space in a single run, whereas the older method required a sequence of runs to approximate such a limiting solution. However, Pareto-optimality does not guarantee a satisfactory design, since such solutions may emphasize some objectives at the expense of others. The designer must still interact with the program to obtain a well-balanced set of objectives. Using the example of a fighter lateral stability augmentation system (SAS) design over five flight conditions, several effective techniques are developed for obtaining well-balanced Pareto-optimal solutions. For comparison, one of these techniques is also used in a recently developed algorithm of Kreisselmeier and Steinhauser, which replaces the hard constraints with soft constraints, using a special penalty function. It is shown that comparable results can be obtained. (Author)

A81-45522 **Optimal multirate flight control design.** J. R. Broussard and D. P. Glasson (Analytic Sciences Corp., Reading, MA). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 7 p. (WP1-E). 9 refs. Contract No. N00014-79-C-0431.

A new approach to multirate control synthesis based on optimal regulator theory is described in this paper. The present technique obviates dimensionality problems typical of classically based techniques and offers a systematic procedure for designing multirate controllers to meet continuous-time or real frequency domain specifications. Mathematical developments of the multirate regulator and proportional-plus-integral (PI) controllers are presented. An example system is designed and its properties are compared to those of an equivalent single-rate system. (Author)

A81-45539 * **Generic multi-body formulation of heavy lift airship equations of motion.** R. F. Ringland, M. B. Tischler, I. L. Ashkenas, and H. R. Jex (Systems Technology, Inc., Hawthorne, CA). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 10 p. (TA1-C). 26 refs. Contract No. NAS2-10330.

This paper describes the formulation of a comprehensive set of equations which describe the dynamic behavior of a generic heavy lift airship (HLA). They are being used in a digital computer simulation to investigate the response dynamics and flying qualities of HLAs operating with various payloads in a variety of operational

environments. A key feature is the separate treatment of each component body making up the HLA. This allows the analyst to vary the configuration (e.g., number of lift-propulsion units, presence or absence of slung payload, etc.) without rewriting the equations. It further provides measures of key structural and control loads acting on the HLA and eases the task of modeling wind disturbances. (Author)

A81-45540 Adaptive multivariable model following. E. G. Rynaski (Calspan Advanced Technology Center, Buffalo, NY). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 6 p. (TA2-A).

Requirements for multivariable model following are investigated in this paper. A control law is specified that is independent of the dynamics of the model, allows for a model as low as first order regardless of the plant order and generally specifies a limited need to identify the plant stability and control parameters. If the plant transmission zeros are minimum phase, the model following system is stable. A method of eliminating initial transients between the model and the plant is presented. Two examples are given to show the efficacy of the design technique. In the first example, a model following control law is defined for the X-22A V/STOL research aircraft and demonstrates frequency-time domain relationships of the control law calculations. The second example presents flight data results for the USAF/Calspan Total In-Flight Simulator (TIFS) airplane. (Author)

A81-45551 * Sensor/actuator failure detection and isolation for airbreathing propulsion systems. G. G. Leininger (Purdue University, West Lafayette, IN) and K. Behbehani (Toledo, University, Toledo, OH). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 5 p. (TP4-B). 12 refs. Grant No. NsG-3084.

In this paper, the Generalized Likelihood Ratio (GLR) test is used to detect and isolate sensor and/or actuator failures when a digital computer simulation model of the physical system is available. The input to the GLR detector is an innovation sequence formed by subtracting the model outputs from the sensed outputs. Application of the GLR detector to the General Electric QCSEE turbofan engine demonstrates the utility of the proposed procedure. (Author)

A81-45553 Real-time estimation in advanced turbofan engines. R. K. Sahgal, B. A. Anderson, R. D. Hackney (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, FL), and G. T. McKee (Sanders Associates, Nashua, NH). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 7 p. (TP4-E). 12 refs.

The feasibility of using an observer as an active part of an advanced turbofan control system to dynamically estimate engine parameters of interest is demonstrated. The observer estimates engine parameters that may be used for protection, direct control, analytical redundancy and/or diagnostic analysis. Turbine temperature, a prime protection parameter for jet engine control, is difficult to measure responsively and accurately. Analytical estimates based on information already available within the control system provide an alternate source for temperature information. This paper presents a practical method of calculating real time estimates, including turbine temperature, required for engine control and diagnostics. (Author)

A81-45573 Output predictive algorithmic control - Precision tracking with application to terrain following. J. G. Reid, J. T. Silverthorn (USAF, Institute of Technology, Wright-Patterson AFB, OH), and D. E. Chaffin (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 8 p. (FA9-F). 13 refs.

The output predictive digital control problem is formulated as an overdetermined linear least squares problem with considerable design flexibility. An efficient numerical technique is derived for its solution, and some 'rules of thumb' are given for the selection of the design parameters. The control switch time is seen to be an important factor affecting robustness, and a 'robust' design strategy for selection of this time is presented. The greatest power of the control technique is seen in the tracking task. A hypothetical terrain following example shows the digital, closed loop, predictive controller to be both extremely high in 'bandwidth' and to have a very short 'settling time'. (Author)

A81-45588 General describing function method for systems with many nonlinearities, with application to aircraft performance. J. H. Taylor (Oklahoma State University, Stillwater, OK). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 2. New York. Institute of Electrical and Electronics Engineers, Inc., 1980. 6 p. (FP9-A). 8 refs. Contract No. N00014-75-C-0432.

It is shown that the Sinusoidal-Input Describing Functions (SIDFs) technique described is useful in the investigation of limit cycle conditions in completely general multivariable nonlinear systems. Restrictions on the type and number of nonlinearities, system configuration and the presence of constant inputs have been completely removed. In general, the results obtained bolster the expectation that the iterative LC analysis technique will be found to converge in such a way as to locate limit cycle conditions, provided that limit cycles exist. A major point of departure from previous SIDF analysis methods is the substitution of root locus-like plots of 'quasi-linear eigenvalues' in lieu of frequency domain SIDF techniques for multivariable systems. O.C.

A81-45602 # Lighting systems for flight support (Svetotekhnicheskie sistemy obespecheniia poletov). P. L. Andreev, I. S. Gladysh, and V. A. Voevodzinskii. Moscow, Izdatel'stvo Transport, 1981. 279 p. In Russian.

The book is concerned with the maintenance of lighting systems used in civil airports. Subjects discussed include: maintenance of transformer substations, transmission lines, power plants, and lighting plants, and troubleshooting of cable lines. Particular attention is given to the design, operation, adjustment, and maintenance of thyristor brightness controllers. V.L.

A81-45603 # Flight-vehicle production technology (Tekhnologiia proizvodstva letatel'nykh apparatov). A. N. Kvasha, D. N. Medvedev, V. E. Prikhod'ko, and A. P. Sergeev. Moscow, Izdatel'stvo Mashinostroenie, 1981. 232 p. 28 refs. In Russian.

Processes used for the manufacture of aircraft components and aircraft assembly are reviewed. Attention is given to the general principles of aircraft building, development of production routes, the use of lofts and templates, sheet metal cutting and stamping, bending, drawing, and machining techniques. Special precision machining techniques discussed include electric spark and electrochemical machining, plasma and laser techniques, ultrasound treatment, and surface treatments such as burnishing and shot blasting. Consideration is also given to methods used to produce permanent joints, including fusion and resistance welding, electron-beam welding, pressure welding, welding of plastics, soldering, bonding, and riveting. Finally, assembly processes and testing are discussed. V.L.

A81-45608 # Aircraft instruments and measuring systems (Aviatsionnye pribory i izmeritel'nye sistemy). V. G. Vorob'ev, V. V. Glukhov, A. L. Grokhol'skii, I. A. Ivanov, I. K. Kadyshev, I. V. Kal'berg, L. M. Malikov, P. I. Trifonov-Bogdanov, and G. K. Ianko. Moscow, Izdatel'stvo Transport, 1981. 392 p. 51 refs. In Russian.

Instruments and measuring systems used in aircraft and helicopters are described with reference to their basic characteristics, principles of operation, measurement errors, and maintenance procedures. The instruments discussed include pressure gauges, thermometers, fuel and oil gauges, fuel flow meters, vibration meters, position indicators, and combined instruments. Other instruments and systems covered in the book are: high-altitude and oxygen equipment, altimeters, velocimeters, angle-of-attack and slip indicators, gyroscopic instruments and systems, inertial navigation systems, and data display recording systems. V.L.

A81-45747 **SR-71 impressive in high-speed regime.** R. R. Ropelewski. *Aviation Week and Space Technology,* vol. 114, May 18, 1981, p. 46-51, 53, 54, 56.

An account is given of the flight characteristics and operational capabilities of an SR-71 aircraft of the Air Force's Ninth Strategic Reconnaissance Wing. Among the issues covered are: (1) flight crew preparation; (2) hangar safety; (3) cockpit control, avionics and inertial and celestial navigation systems; (4) fuel and center of gravity management during mission; (5) propulsion system characteristics, with attention to the pseudo-ramjet functioning of the J-58 engines at Mach 3.0 cruise speeds; and (6) automated surveillance sensor operation. Mission profile contingencies covered include engine failure and engine inlet unstart. It is reported that an extensive review of flight control and subsystem management technology is underway, with a view to the installation of a digital flight control system. O.C.

A81-45748 **SR-71 imposes burden on maintenance units.** *Aviation Week and Space Technology,* vol. 114, May 18, 1981, p. 105-108.

An overview is given of the maintenance requirements of the SR-71 reconnaissance aircraft. Attention is given to the consequences for inspection, maintenance and repair operations of (1) peak temperatures ranging from 400 to 1200 F over the aircraft surface during supersonic cruise, (2) the impossibility of sealing fuel tanks, integral with the airframe, which must expand and contract over that temperature range; (3) the special lubrication and hydraulic systems needed for high-temperature operation; (4) the need for special heat-treatment of all fasteners; and (5) the custom-built nature of SR-71 airframes, for which dimensional commonality cannot be established. Emphasis is also put on the disappearance of many of the aircraft's original subcontractors or their line of products, such as the J-58 engine, and the loss of highly trained maintenance personnel to private industry. An extensive maintenance role now exists for civilian technicians contracted from manufacturers. O.C.

A81-45755 # **The roles of airline engineering and maintenance in 1981 (La función de ingeniería y mantenimiento de una línea aérea en 1981).** C. Soria Silla (Iberia Líneas Aéreas de España, Madrid, Spain). *IAA/Ingeniería Aeronáutica y Astronáutica,* vol. 33, Apr. 1981, p. 5-44. In Spanish.

A comprehensive study (a review of the January 1981 ATLAS Conference) is presented concerning the engineering design and airline maintenance operations measures that seem most urgent and feasible for the reduction of direct operating costs generally and fuel expenditures in particular. Attention is also given such varied topics as preventive maintenance, reliability, decision diagrams, avionics, noise and chemical pollution, weight reduction, engine design, the availability of strategic materials such as titanium and cobalt, the optimization of maintenance procedures, airline organization, and research and development cooperation among the five European airlines (Air France, Sabena, Iberia, Alitalia and Lufthansa) constituting the ATLAS organization. O.C.

A81-45756 # **A new aircraft is born - The CN-235 (Nace un nuevo avión - El CN-235).** F. Aranaz del Rio. *IAA/Ingeniería Aeronáutica y Astronáutica,* vol. 33, May 1981, p. 5-14. In Spanish.

A description is given of the design features, operational capabilities, performance figures and economic prospects for the Spanish-Indonesian CN-235 aircraft program. The craft, powered by two CT7 turboprops, features the possibility of rapid conversion from a 34-38 passenger seating internal configuration to a volume for the accommodation of two P-88, five LD-2 or four LD-3 cargo pallets. An overview is also provided of the distribution of development program responsibilities between the manufacturers, CASA (Spain) and Nurtanio (Indonesia). Extensive dimensional and performance data cite maximum cargo and fuel weights of 4,500 and 4,000 Kg, respectively. Engine certification is expected in 1983, and full-scale production of the aircraft in 1984. O.C.

A81-45759 # **New technologies in future commercial aircraft (Nuevas technologías en los futuros aviones comerciales).** J. Carlos Meizoso (Iberia Líneas Aéreas de España, Madrid, Spain). *IAA/Ingeniería Aeronáutica y Astronáutica,* vol. 33, June-July 1981, p. 5-21. In Spanish.

Prospective applications of new techniques over the next 10-15 years in the fields of (1) aerodynamics, (2) structures, (3) propulsion, and (4) systems and avionics are presented with a view to reducing the direct operating costs, environmental effects and operational complexity of commercial aircraft. Among the topics discussed are super-critical wing design, wing downwash effects reduction, laminar flow control, series 2000 and 7000 aluminum alloys, sintered materials, titanium alloys, and carbon and Kevlar composites. Also considered are the computer analysis of turbomachine rotor stress, CAD-CAM techniques, the NASA Energy Efficient Engine program, 767 avionics and cockpit displays, and active load-alleviation flight control systems. O.C.

A81-45760 # **Project Prosat (Proyecto Prosat).** A. Lorente Arcas. *IAA/Ingeniería Aeronáutica y Astronáutica,* vol. 33, June-July 1981, p. 23-33. 12 refs. In Spanish.

A detailed description is given of the Prosat project, which is an experiment employing mobile terminals and three geostationary Marecs satellites in L- and C-band control and communication for land, sea, and especially air traffic in the Atlantic, Pacific and Indian Oceans. The system envisioned comprises three operational modes: (1) ATC, or air traffic control; (2) COM, or communications; and (3) FIX, which permits isolated stations participating in the system to interface with the existing aeronautical telecommunications network. The longitudinal positions contemplated for the three geostationary satellites are: 52 deg W (Atlantic), 68 deg E (Indian Ocean), and 172 deg W (Pacific). Equipment requirements, performance capabilities and management schemes for the project are considered. O.C.

A81-45761 # **The application of computers to navigation - New developments employing microprocessors (I calcolatori applicati alla navigazione - Nuovi sviluppi con l'impiego del microprocessore).** A. Strumia (Società Italiana Avionica S.p.A., Turin, Italy). *Istituto Italiano di Navigazione, Atti,* Apr.-Sept. 1980, p. 5-15. 7 refs. In Italian.

After giving historical, technological and economic accounts of digital computer applications, the structure of a modern computer is examined with attention to its most recent development, the microprocessor. An overview is then given of the latest applications in aerial navigation, where the microprocessors play a major role in avionics devices and in the architecture of integrated systems. The importance of software development is stressed, with the software modification system of the 767 exemplifying the degree of flexibility of all newly developed navigation avionics. The navigational systems discussed involve inertial, instrument and radio navigation. Also covered are costs related to the hardware/software ratio. O.C.

A81-45762 # **The development of secondary radar in air traffic control (Lo sviluppo del radar secondario nel controllo del traffico aereo).** R. Chirici (Selenia S.p.A., Rome, Italy). *Istituto Italiano di Navigazione, Atti,* Apr.-Sept. 1980, p. 17-42. 9 refs. In Italian.

After a brief review of the principles of operation of secondary radars, the limits of such systems as presently constituted are discussed and a series of improvements are proposed. Among the topics covered are cooperative secondary surveillance radars, lateral lobe suppression, antenna system configurations, sweep equalization and radar illumination equalization operations, interleaving and garbling, electromagnetic interference and the proposed DABS and ADSEL new-generation radars. Detailed system characteristics and operational capability figures are given for the DABS and ANSEL systems, with attention to the application of real time and dwell time digital processors and monopulse techniques. Schematic and block diagrams are presented together with technical characteristics of the system. O.C.

A81-45763 # **Prospects for the employment of dirigibles in the 1980s (Prospettive di impiego del dirigibile negli anni 80).** A. Castellani (Roma, Università, Rome, Italy). *Istituto Italiano di Navigazione, Atti,* Apr.-Sept. 1980, p. 59-67. 5 refs. In Italian.

A review is made of the extent of current interest in the development of lighter-than-air systems, and of the capabilities and advantages of such craft by comparison with fixed-wing and rotary-wing aircraft. Among the novel vehicle configurations considered are the helicopter-rotor controlled and propelled Megalifter, the ONERA Project Hope deltoid airship, with a cargo capacity of 500 tons, and the Dynairship, a hybrid craft incorporating wings.

Detailed recommendations are made for the development of two commercially feasible airship sizes: (1) mini-dirigibles having a cargo capacity of 2.5-5.0 tons, useful in scientific observation, traffic surveillance and emergency operations; and (2) dirigibles with a cargo capacity of 10-55 tons for transport in and out of areas with limited infrastructures. Speed, estimated costs and range are also provided. O.C.

A81-45764 # **Trends in the future development of air traffic control systems (Tendenze future nello sviluppo dei sistemi di controllo del traffico aereo).** G. Fraddosio (Compagnia Italiana Servizi Tecnici S.p.A., Rome, Italy). *Istituto Italiano di Navigazione, Atti,* Oct.-Dec. 1980, p. 5-9. In Italian.

Consideration is given the state-of-the-art of air traffic control radars in the year 2000, extrapolating from recent technology development trends. It is shown that in all probability: (1) primary radar will develop in the direction of increasing data rates and active phased-array configuration, eventually yielding three-dimensional imagery devoted to security surveillance; (2) secondary radar will evolve intelligent data-link structures for tactical anticollision operations; and (3) satellite telecommunications will allow flight management and control to be conducted on the largest scale, connecting sources and users of geographical and meteorological radar data. O.C.

A81-45766 # **Navigation and landing - The prospects of new systems (Navigazione ed atterraggio - Prospettive offerte da nuovi sistemi).** F. Chiarini (Industrie FACE Standard, Milan, Italy). *Istituto Italiano di Navigazione, Atti,* Jan.-June 1981, p. 5-16. In Italian.

The history of MLS is reviewed, with particular attention given to the TRSB (Time Reference Scanning Beam) system and DMEM (DME for the MLS). The performance of MLS is compared with that of ILS in terms of channel capacity, operational flexibility, compatibility between civilian and military users, signal repeatability, and cost. Finally, the prospects of research on navigation and landing in Italy are briefly considered. B.J.

A81-45767 # **An integrated Omega/satellite radio navigation system (Sistema integrato di radionavigazione Omega/satellitare).** F. Esposito (Elmer, Pomezia, Italy). *Istituto Italiano di Navigazione, Atti,* Jan.-June 1981, p. 63-72. In Italian.

The paper describes the characteristics of an integrated navigation system that combines the Transit satellite system and the ground-based Omega. The two systems are first described separately, and then the integrated system is examined, with emphasis on the SP-1090 instrument, NAV 1, and NAV 2. The advantages of the system, which include operational simplicity, reliability, precision, and cost effectiveness, are described. B.J.

A81-45891 # **Progress toward a long-range propulsion plan.** C. F. Baerst, R. C. Gunness, and S. W. Mitnik (Garrett Turbine Engine Co., Phoenix, AZ). *AIAA, SAE, and ASME, Joint Propulsion Conference, 17th, Colorado Springs, CO, July 27-29, 1981, AIAA Paper 81-1503.* 7 p. Contract No. N00019-80-C-0226.

An advanced technology engine study is being conducted to investigate ways of reducing engine-related life cycle costs. Tradeoff studies are made to review engine requirements, design practice, as well as development and deployment strategies. The program consists of three separate tasks, the first of which is discussed in detail: the weapon/propulsion definition and the initial assessment of the multiple application core engine concept. The baseline engines and weapon systems are illustrated, and tables are provided, showing engine cycle optimization. J.F.

A81-45892 # **The predictability of turbine vane convection heat transfer.** D. K. Winstanley, T. C. Booth (Garrett Turbine Engine Co., Phoenix, AZ), and M. G. Dunn (Calspan Advanced Technology Center, Buffalo, NY). *AIAA, SAE, and ASME, Joint Propulsion Conference, 17th, Colorado Springs, CO, July 27-29, 1981, AIAA Paper 81-1435.* 9 p. 21 refs.

A measurement data base for gas turbine flow-path heat transfer was developed under the sponsorship of the U.S.A.F. The data base consisted of discrete heat flux and pressure measurements obtained using a helium-driven shock tube facility, thin-film heat flux gauges, and fast-response pressure transducers. Several predictive technologies for turbine heat transfer are compared to this data base: the vane sector cascade data is compared to flat-plate correlations, a 2-D parabolic boundary layer code, and a 3-D viscous code. Results of these calculations indicate that turbulent flat-plate correlations and post-transition boundary layer codes generally overpredict surface heat transfer, especially on or near the vane suction surface. The 3-D calculation reasonably predicts the heat transfer distribution on the endwalls where transition is not a dominant factor. It is shown that existing predictive tools, though sufficient for preliminary design, need improvement to achieve optimum turbine cooling designs. J.F.

A81-45893 * # **The design and development of a mixer compound exhaust system for a quiet clean general aviation turbofan.** W. L. Blackmore and C. E. Thompson (Garrett Turbine Engine Co., Phoenix, AZ). *AIAA, SAE, and ASME, Joint Propulsion Conference, 17th, Colorado Springs, CO, July 27-29, 1981, AIAA Paper 81-1494.* 8 p. 8 refs. NASA-sponsored research.

Lower engine fuel consumption has become a dominant factor in turbofan engine design due to rapidly increasing fuel costs. One engine component with a large impact on engine performance is the exhaust system. Previous exhaust system studies have demonstrated the significant exhaust system efficiency gains available through mixing of the core and bypass flows. Typically, a large, costly rig and engine program are required to develop and optimize these gains. The purpose of this paper is to present the results of the low-cost design system used for the quiet, clean general aviation turbofan mixer nozzle design and development. The scale model and full-scale engine test results confirm the predicted 3 to 5% reduction in cruise fuel consumption. This unique design system, which is based on integrating advanced three-dimensional viscous numerical methods with empirical optimization techniques, is summarized and detailed comparisons with test data are presented. The ability to accurately predict relative performance of mixer systems with substantially reduced development time and cost savings is demonstrated. (Author)

A81-45894 # ***Design of fault tolerant electronic engine controls.*** L. E. Baker (Systems Control, Inc., Palo Alto, CA), D. E. Warner (Ford Motor Co., Detroit Diesel Allison Div., Indianapolis, IN), and C. P. Disparte (Delco Electronics, Santa Barbara, CA). *AIAA, SAE, and ASME, Joint Propulsion Conference, 17th, Colorado Springs, CO, July 27-29, 1981, AIAA Paper 81-1496.* 11 p. 5 refs. Contract No. F33615-79-C-2002.

A practical design approach and methodology for a full-authority, fault-tolerant electronic engine control (FAFTEEC) system is presented. The approach blends hardware and software redundancy considerations and provides a reasonable basis for evaluating the critical factors which influence the design: cost of ownership, performance, weight, reliability, and availability. The effort focuses on the definition of the baseline control system, the formulation of the data base, the development of a component reliability/cost model, and the evaluation of a redundant configuration. The FAFTEEC systems integration, program approach, digital controller, and baseline control system are illustrated; the life cycle cost flow is given, as is a list of the major LCC drivers for aircraft engines. J.F.

A81-45974 # **Design, analyses, and model tests of an aeroelastically tailored lifting surface.** W. A. Rogers, W. W. Braymen (General Dynamics Corp., Fort Worth, TX), and M. H. Shirk (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH). *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1673.* 15 p. 20 refs. USAF-sponsored research.

Aeroelastic tailoring provides a measure of control over the interaction of aerodynamic loading and structural response during the design of composite lifting surfaces. A recent investigation involving the design, fabrication, and test of an aeroelastically tailored fighter wing was conducted to provide data for validating the design methodology. Three sets of composite wings with different design objectives were tested in addition to a set of rigid steel wings. The static aeroelastic tests featured the measurement of model forces, pressure distributions, and deflected shapes in the transonic regime. Test results are compared with analytical predictions and show significant aeroelastic benefits. (Author)

A81-46023 **Spin - Angles and inertial moments.** P. J. Yangos and J. P. Yangos (Hellenic Air Force, Technology Research Center, Athens, Greece). *Aeronautical Journal,* vol. 85, July-Aug. 1981, p. 270-276. 9 refs.

A review is presented of the serious mathematical complications of the kinetics of aircraft spin, with attention to the problems that arise in attempts at simplification of complex models. Among the issues considered are: (1) rotation, moments and angles; (2) pictorial representation of spin angles; (3) analytical relations between spin angles; (4) alternative functions in inertial moments; and (5) the expression of an aircraft's simplified pitching moment. Numerous proposals are made for the reformation of model notation and terminology and examination of the necessity of certain accepted concepts. O.C.

A81-46276 # **Origins of inertial navigation.** C. S. Draper (Charles Stark Draper Laboratory, Inc., Cambridge, MA). *Journal of Guidance and Control,* vol. 4, Sept.-Oct. 1981, p. 449-463.

A description is presented of some of the major systems that contributed to the evolution of inertial navigation, and a record is provided of the performance of some of the historically significant programs. An underlying theme is the continuity of gyroscopic sensor technology from the fire control systems of the Mark 14 vintage to the first successful inertial navigators. It is shown how the single degree of freedom gyroscopic element was adapted to perform simultaneously both the sensing and computation requirements for solving the fire control problem associated with close-in attacking aircraft. Refinements made to this gyroscopic element, including precise control of torques applied to the output gimbal, and eventual flotation led to the sensor technology that was eventually adapted to solving the inertial navigation problem. G.R.

A81-46280 # **Output predictive algorithmic control - Precision tracking with application to terrain following.** J. G. Reid (Lear Siegler, Inc., Dayton, OH), D. E. Chaffin (USAF, Avionics Laboratory, Wright-Patterson AFB, OH), and J. T. Silverthorn (USAF, Institute of Technology, Wright-Patterson AFB, OH). *Journal of Guidance and Control,* vol. 4, Sept.-Oct. 1981, p. 502-509. 12 refs.

The output predictive digital control problem is formulated as an overdetermined linear least-squares problem with considerable design flexibility. An efficient numerical technique is derived for its solution, and some 'rules of thumb' are given for the selection of the design parameters. The control switch time is seen to be an important factor affecting robustness, and a 'robust' design strategy for selection of this time is presented. The greatest power of the control technique is seen in the tracking task. A hypothetical terrain-following example shows the digital, closed-loop, predictive controller to be extremely high in 'bandwidth' and to have a very short 'settling time'. (Author)

A81-46325 **Limb restraint F-18 style.** B. A. Miller (Martin Baker Aircraft Co., Ltd., Higher Denham, Middx., England). *SAFE Journal,* vol. 11, Summer 1981, p. 12-15.

The need for good limb restraint is important whenever a high performance aircraft is likely to operate at lower altitudes exposing the pilot to the possibility of ejection at high indicated airspeeds. A review of various past restraint system designs is presented first; a detailed description of the current restraint systems applied to the Martin Baker SJU-5/A seat of the F-18 Hornet is then given. The review concentrates on the U.S. Navy torso harness and the combined harness, which provides advantages over the former in areas of single point donning and release, cost, attrition and comfort; leg and arm restraint systems are also discussed. It is concluded that although both the torso and leg restraint systems perform well, the arm restraint system needs some final refinement in design. The aim to incorporate restraint systems which demand little or no special actions by the pilot and which in no way hinder his normal flight operations has been realized. J.F.

A81-46334 **RB.199 - Compact Tornado power.** F. Munger. *Flight International,* vol. 120, Aug. 22, 1981, p. 552-558.

A development status report is presented for the RB.199 low-bypass turbofan powerplant of the Tornado fighter, of which 2,000 are scheduled for construction in a cooperative venture involving British, Italian and German manufacturers. In addition to reviewing the design features and both present and projected performance characteristics, the distribution of construction and development characteristics is described. It is believed that the basic design can reach the 20,000-lb thrust class, or 20-25% greater output than at present, through increases of airflow and hot section operating temperatures. A detailed cut-away drawing of the engine is included. O.C.

A81-46340 # **Soviet practice in designing and procuring military aircraft.** R. D. Ward (General Dynamics Corp., Fort Worth, TX). *Astronautics and Aeronautics,* vol. 19, Sept. 1981, p. 24-38.

A detailed historical review is presented of the changing organization of military aircraft design, development and production in the Soviet Union since the end of the Second World War. Attention is given the policy-making hierarchy of such ministries as Defense and Aircraft Production, and the distribution of responsibilities among the research institutes comprising the Ministry of Aircraft Production: (1) the Central Aero-Hydrodynamics Institute; (2) the Scientific Research Institute for Aircraft Equipment; (3) the All-Union Institute of Aviation Materials; (4) the Flight Research (Test) Institute; (5) the Scientific Research Institute for Aviation Technology and Organization of Production; (6) the Central Institute of Aviation Motor Building; and (7) the Central Design Office, which directs the eight experimental-design bureaus engaged in detail design and construction of prototype aircraft. Extensive differences between fighter and bomber aircraft design methods are noted. O.C.

A81-46345 **Creep properties of single-crystal nickel-based superalloys. II - Creep at medium temperature /760 C/ (Propriétés en fluage de monocristaux de superalliages à base de nickel. II - Fluage à moyenne température /760 C/).** C. Carry (Lausanne, Ecole Polytechnique Fédérale, Lausanne, Switzerland), C. Houis, and J. L. Strudel (Paris, Ecole Nationale Supérieure des Mines, Evry, Essonne, France). *Mémoires et Etudes Scientifiques de la Revue de Métallurgie,* vol. 78, July-Aug. 1981, p. 337-343. 12 refs. In French. Research supported by the Ministère des Armées and Ministère de l'Industrie et de la Recherche.

A comparison is presented of the finely dentritic worked structures and those completely free of dendrites in MAR-M 200 single crystals under creep conditions at 760 C and under heavy loads (700 MPa). Each sample was subjected to two types of heat treatment (1350 C for one hour followed by 870 C for 64 hr; and 1350 C for one hr, followed by 760 C for 24 hr) prior to the occurrence of creep. It is shown that in the homogeneous structures total resolution of the gamma phase is possible in MAR-M 200 by treatment at 1350 C for one hour. Results can be applied to the study of aircraft gas turbines. K.S.

A81-46352 * **Aircraft noise control in the 1980's.** H. H. Hubbard and H. G. Morgan (NASA, Langley Research Center, Acoustics and Noise Reduction Div., Hampton, VA). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 1. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 33-62. 35 refs.

It is pointed out that a need exists for the orderly development of technology and engineering methods for noise control of all types of aircraft. The nature and scope of aircraft noise problems are reviewed, and a description is provided of noise control progress made to date. The most serious aircraft noise problems confronting communities in the past two decades have been associated with the subsonic air carrier jet transport. Operational trends related to traffic growth and operational constraints are examined, and noise level trends are considered, taking into account engine cycle developments, the role of Federal noise certification, future noise exposures, and multiple noise sources. Advanced source noise reduction technology developments are discussed along with a noise impact assessment, and advanced operating procedures. Attention is also given to engine noise and sonic boom exposures in connection with supersonic air carrier aircraft, and exterior and interior noise control related to propeller/rotor aircraft. G.R.

A81-46353 **EPA proposed national strategy for further reduction of aviation noise.** R. J. Koenig (U.S. Environmental Protection Agency, Washington, DC). In: Inter-noise 80: Noise

control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 1. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 123-126.

Based on actions taken to date, in the year 2000 there would still be approximately 2.5-million people living in areas exposed to average outdoor noise levels, from aviation operations, of 65 dB or above. The EPA proposes a national strategy for dealing with these remaining cases of high noise exposure from aviation. To be fully successful this proposed strategy must receive the support and active involvement of the FAA, the aircraft manufacturers, the airlines, the pilots, the airports, elected officials, and airport neighbors. The strategy is focused on providing relief to airport neighborhoods as soon as possible but not later than the year 2000. Since the nature of the aircraft fleet is to a large extent already determined by actions previously taken, the strategy for this period is targeted on operation changes and compatible land-use actions. Attention is given to the optimization of aircraft flight procedures, airport noise abatement planning, off-airport land-use management, soundproofing, and relocation. G.R.

A81-46354 Integrated noise model - The Federal Aviation Administration's computer program for predicting noise exposure around an airport. T. L. Connor (FAA, Office of Environment and Energy, Washington, DC). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 1. Poughkeepsie, NY, Noise Control Foundation, 1980. p. 127-130.

The FAA believes that the method to be used for flexible and effective noise planning should suitably employ a computer-based mathematical model for producing standardized noise maps and predicting noise impacts. The continuing development of the Integrated Noise Model (INM) ensures that the goal of a standard airport noise planning tool is achievable. The INM determines the total impact of aircraft noise at or around airports. This impact can be given in terms of contours of equal noise exposure for a number of different noise measures. The INM is not only a set of computer programs, but an entire system of activites designed to promote and support the use of the airport noise analysis tool. The INM Development Program is the mechanism by which these activities are coordinated. The progress made with respect to each element of the INM Development Program is discussed. G.R.

A81-46355 Airport noise control in the 1980s - FAA's plans and policies. J. E. Wesler (FAA, Washington, DC). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 1. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 131-134. 9 refs.

It is pointed out that aviation noise will remain a serious problem during the next decade. The steps taken by the FAA to control and reduce aircraft noise are briefly considered. It has been possible to reduce aircraft noise in connection with the design of new aircraft. Advisory procedures have been issued for noise abatement departure procedures. However, all actions taken together will not eliminate aircraft noise. A further reduction of noise emission at the source would require new technological developments, and is consequently at least some years away. For these reasons, the burden of airport noise control in the 1980s is going to fall on airport operators and local governments. In its Aviation Noise Abatement Policy statement, the Federal government stated the basic concept that aviation noise abatement is a shared responsibility among all elements of the aviation industry. Airport operators are primarily responsible for local actions to reduce the effects of noise on residents surrounding their airports. G.R.

A81-46356 Remaining problems in the prediction, measurement, evaluation, and control of aircraft noise. N. Shapiro (Lockheed-California Co., Burbank, CA). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 1. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 337-340. 8 refs.

In 1972 the Society of Automotive Engineers published a list of aircraft noise problem areas needing investigation. Looking through that list now, it can be seen that some significant advances have been made, but there is little, if anything, that can actually be deleted. The renewed interest in energy-efficient propeller-powered aircraft, using the recently developed prop-fans, has revived propeller noise research. Of particular concern are the forward flight effects on far-field noise and the near-field noise characteristics of supersonic tip speed propellers. Control of fuselage transmission of the relatively low frequency propeller noise again needs attention. The noise sources of a jet engine are considered, taking into account the jet exhaust noise, particularly that from the coannular flow of a turbofan engine. Attention is also given to the desirability of a better understanding of 'flight effects', noise propagation, acoustic measurements, and an evaluation of noise impact. G.R.

A81-46357 Investigation of the physical working environment for cabin attendants within Scandinavian Airlines System /SAS/. U. Sundback and B. Tingvall (Lulea, Hogskola, Lulea, Sweden). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 1. *Poughkeepsie, NY, Noise Control Foundation*, 1980, p. 341-344.

The considered investigation was conducted on board a number of aircraft during regular flights. The investigation was mainly concerned with noise conditions and the vibrations to which the entire body of a cabin attendant had been subjected. The types of aircraft studied included the Douglas 8, Douglas 9, Douglas 10, and Boeing 747. The noise was recorded with the aid of tape recorders at various locations in the cabin, taking into account different phases of the flight. Four cabin attendants were carrying noise dose meters during their entire working period in order to record the amount of noise they are exposed to. The vibration levels were found to be very low. In most cases the levels are below the reference curves for 'fatigue decreased proficiency' except for measurements conducted on a DC 8 at a jump seat at the back galley. G.R.

A81-46363 Model for airport noise exposure on a national basis - 1960 to 2000. K. M. Eldred (Bolt Beranek and Newman, Inc., Cambridge, MA). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 2. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 803-808. 11 refs.

The effective perceived noise level and noise exposure forecast descriptors are used to calculate cumulative noise levels, which utilize perceived noise level frequency weighting and A-frequency weighting, respectively. The contour noise levels, sizes, shapes and populations encompassed for a specific airport depend on seven factors, including noise vs distance and number of operations by aircraft type, stage lengths, flight procedures, and spatial distribution of population. A simplified method for noise control analysis is discussed, based on two subsets of the seven factors, airport noise characteristics, and airport noise impact potential. The simplified method is also applied to estimate national impact with change in fleet mix and operations between 1975 and 2000. It is found that a long term solution for the impact of airport noise requires minimizing both the airport noise impact potential and airport noise characteristic levels. D.L.G.

A81-46364 Plans for control of the noise exposure produced by military aircraft in the 1980's - Aircraft noise. G. D. Vest (USAF, Environmental Div., Washington, DC). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 2. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 809-812. 15 refs.

Controlling noise exposure due to military aircraft in the 1980s is discussed, recognizing that combat performance and training requirements impose severe limitations on airborne noise source reduction alternatives. The DOD policy regarding aircraft noise is given, and several improvements with the latest generation of combat aircraft are presented, including the A-10, F-15 and F-16. Primary emphasis is on cooperative land use planning, formulized as the Air Installation Compatible Use Zone program, which contains a study of accident potential zone maps, noise and land use zone maps, and

flight track maps. The program to date has been successful, producing positive actions by other agencies, and adopting a balanced program focusing on the noise source, path and receiver. D.L.G.

A81-46366 **Noise control at general aviation airports.** W. J. Critchfield and C. E. Nay (Torrance Municipal Airport, Torrance, CA). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 2. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 827-830.

Noise control at general aviation airports is illustrated by a program at the Torrance, CA Municipal Airport. Although in existence for 24 years, the plan became effective within the last four years at a cost of $750,000. Effectiveness is based on the degree of political, economical, and professional commitments. Designing the noise abatement program is discussed, with emphasis on community cooperation and pilot education, and flight patterns are redefined, rather than limiting frequency of operations. Good results are produced, and include reduced noise in surrounding residential areas, and increased financial feasibility and operational capability. D.L.G.

A81-46367 **Airport noise contour predictions - Improving their accuracy.** W. J. Galloway (Bolt Beranek and Newman, Inc., Canoga Park, CA). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 2. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 835-838.

A working group of SAE Committee A-21, Aircraft Noise, was formed to propose standards to derive data for use in airport noise computations and to specify algorithms to perform the computations. An A-weighted sound exposure level is specified as the recommended measure for the noise from a single flyover, based on data obtained from airport monitoring equipment. The procedure is designed to reduce the levels at 10,000 feet, for example, by 4 dB relative to other procedures. Ground-to-ground and low angle propagations are also discussed, and flight path prediction obtained by observing a series of flight operations on radar, are found essential to predictions of accurate noise contours. It is concluded that good definitions of noise data and aircraft operating conditions provide substantial improvement in noise contour accuracy, although further attention is needed on predictions of start, take-off roll, and acceleration on the runway. D.L.G.

A81-46368 **Airbase induced community noise - Facilitating the military/civil interface.** R. E. Greene (Orange County, Environmental Management Agency, Santa Ana, CA). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 2. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 839-842.

Noise/land-use compatibility planning is discussed to minimize airbase operational constraints and maximize development of noise compatible land use in the vicinity of bases. The military role is presented with emphasis on the Air Installation Compatible Use Zone (AICUZ) program and AICUZ officers approach of community leaders. The civil government role is also presented, and a military/civil partnership is recommended to implement a noise control/noise compatible land use strategy. The program existing at Orange County, CA, is used to illustrate the implementation phase, where single event mitigation criteria is considered a partial solution to the problem of high variability of source noise emission from military jet aircraft. D.L.G.

A81-46369 **Optimizing complex runway use programs for airport noise abatement.** R. L. Miller (Bolt Beranek and Newman, Inc., Cambridge, MA). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 2. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 843-846.

Airport noise abatement at Logan International Airport in Boston is investigated to optimize a runway use program. A single priority system is found to often cause overutilization of a runway, and the noise exposed population is presented as a function of runway utilization to help establish priorities for alternate impact criteria. A definition of impact is made, based on health and welfare effects on complaint data or on political expedience, which is quantifiable in terms of exposure levels. Other factors influencing the set of optimum utilization are also presented, such as wind and weather constraints on runways. Minimum and maximum utilizations are established for Logan Airport, and a compromise is made which minimizes the number of residents in areas where the L(dn) exceeds 70 and 75 dB, but does not increase the high exposure levels for any group of residents. D.L.G.

A81-46370 **Aircraft noise and land use compatibility tradeoff analyses.** D. E. Bishop (Bolt Beranek and Newman, Inc., Canoga Park, CA). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 2. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 847-850.

Generalizations which extend the usefulness of basic airport noise exposure contour computations are investigated to plan studies that may be obtained from a limited set of noise contours. The basic relationship between day/night level (DNL), aircraft noise levels, and number of events is used in the analysis in addition to the noisemap airport noise modeling program. Different components of the aircraft fleet are layered in preparing the program input, and the contour areas are calculated. Examples are given which show the DNL contour areas for all airport operations, air carrier jets only, and business jets only. Two trends are demonstrated and the figures allow airport goals to be set in quantitative terms of targeted incompatible land use conversion, changes in noise exposure, and levels of air carrier passenger capacity. D.L.G.

A81-46371 ***Optimization of takeoff flight paths with respect to FAR Part 36 noise using dynamic programming.*** A. P. Hays (Lockheed-California Co., Burbank, CA). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 2. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 851-854.

A method of scheduling the thrust and speed of a second generation supersonic transport (SST) to minimize takeoff noise on the ground is presented. Dynamic programming is selected as the optimization method, which is used for trajectory optimization and noise minimization. The number of decision-making stages is set to three, and sideline noise remains reasonably constant due to reduced ground attenuation on the sideline noise. The value of minimum traded noise is found from three computer runs, and the optimal control is selected based on minimum cumulative noise energy at the flyover noise microphone. The program can quickly evaluate changes of the aerodynamic propulsion or acoustic characteristics of an SST, and can be modified to determine optimal trajectories for different noise receiver distributions. D.L.G.

A81-46372 **Airport Noise Control and Land Use Compatibility Studies - A U.S. case.** S. Romanoff (Landrum and Brown, Inc., Cincinnati, OH). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 2. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 855-858.

The Airport Noise Control and Land Use Compatibility (ANCLUC) Study, which provides a framework for the consideration of costs and benefits from various noise control strategies is investigated. The ANCLUC Study effort has five phases including noise analysis, identification of community land use/noise conflicts and options for mitigating noise impacts, formulizing recommended noise control and land use plans, and implementation. Each phase is discussed, presenting techniques to minimize airport noise/land use conflicts, maximize economic feasibility, and develop land use patterns for areas experiencing significant noise impacts. It is concluded that a comprehensive examination of social, economic and environmental costs and benefits is necessary for the co-existence of airports and surrounding communities. D.L.G.

A81-46373 **A long range research programme of noise abatement at the airport of Beograd and its practical results.** D. L. Zoric (Beograd, Univerzitet, Belgrade, Yugoslavia), M. R. Vuckovic (Jugoslovenski Aerotransport, Belgrade, Yugoslavia), and D. R. Lukic (Yugoslav Federal Government, Aviation Service, Belgrade, Yugoslavia). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 2. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 859-862. 6 refs.

A brief review is presented of previous and current research on aircraft noise abatement in the Belgrade suburbs. Attention is given to a comparative analysis of data obtained in 1975 (which determined the existing noise level and the exposure of the inhabitants to the aircraft noise), a 1978 verification of the first results, and noise exposure forecasts for 1985 and 1990. Future plans include the construction of an additional runway. K.S.

A81-46374 * **A program to support the full utilization of data from existing social surveys of environmental noise.** J. M. Fields (NASA, Langley Research Center, Hampton, VA). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 2. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 937-940. 21 refs.

A brief review is presented of a three-part project (partially supported by NASA), which promotes greater utilization of social survey data for gaining new information about human response to environmental noise. The goal is accomplished by (1) publishing a catalog of existing social surveys on environmental noise, (2) establishing a data archive for noise survey data sets, and (3) reanalyzing selected surveys to address substantial and methodological issues. A finding about annoyance scales illustrates the use of a comparative analysis. K.S.

A81-46375 **Noise reduction test facilities at Douglas Aircraft.** E. L. Zwieback (Douglas Aircraft Co., Long Beach, CA). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 2. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 1093-1096.

A brief review is presented of several aircraft noise reduction test facilities, ranging from units used for evaluating the basic acoustic characteristics of materials to a large array of field instruments used to determine aircraft flyover noise characteristics. The facilities described include an anechoic acoustic test facility, acoustic test laboratory facilities, an engine noise test facility, and an acoustics/vibration data center. Future trends are indicated. K.S.

A81-46376 **Aircraft noise identification system - Application for inflight position detector.** F. Sasaki (Japan Broadcasting Corp., Technical Research Laboratories, Tokyo, Japan), S. Furukawa, M. Okuda, I. Ono, N. Hayashi (Rion Co., Ltd., Kokubunji, Tokyo, Japan), and G. Nishinomiya. In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 2. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 1121-1124.

An aircraft noise identification system is presented, in which two microphones are used to receive the sound emitted by aircraft. The angle of elevation recorded by the microphones is calculated from the change in the correlation coefficient pattern. Measurements are made by positioning the microphone installations on each side of the aircraft wake. The method, though inferior to radar in precision, can be used to make measurements under a variety of weather conditions and is therefore well suited for flight position (projected altitude and position on the earth) observations. The construction of the in-flight position detector and an example of the graphic recording display are given. J.F.

A81-46377 **The impact and future direction of aircraft noise certification.** M. J. T. Smith (Rolls-Royce, Ltd., Derby, England). In: Inter-noise 80: Noise control for the 80's; Proceedings of the Ninth International Conference on Noise Control Engineering, Miami, FL, December 8-10, 1980. Volume 2. Poughkeepsie, NY, Noise Control Foundation, 1980, p. 1187-1190.

Positive aircraft noise control at the airport vs noise certification is considered, and the need for an adaptation of the latter to the needs of the future is stressed. The difference between airport control and certification control is discussed, methodology being the prime factor. Certification relies on limiting noise levels in fixed locations around an ideal aircraft flight profile, whereas airport control is based on a definition of the constant noise level contour, or the 'footprint'. The 'footprint' concept and the current certification methodology are compared. K.S.

A81-46448 **Determination of coking rate in jet fuel.** A. Vranos, P. J. Marteney, and B. A. Knight (United Technologies Research Center, East Hartford, CT). *Combustion Science and Technology*, vol. 26, Aug. 1981, p. 171-175.

Measurement of coking rate under isothermal conditions has been conducted for a variety of test conditions. Variables included time, fuel flow rate, tube diameter, and surface roughness. Coking rate increases with temperature and Reynolds number, but is not dependent on surface roughness. Examination of deposits by infrared spectroscopy and the electron microprobe indicates that oxygen is present in large concentrations, both singly- and doubly-bonded to carbon; in addition, nitrogen may be present in an imide structure. Transmission electron microscopy indicates the presence of agglomerates of particles about 15 A in diameter. This suggests that insoluble particles originate within the liquid, although the low overall activation energy and the dependence of coking rate on Reynolds number suggest that oxidation of the fuel is mass-transfer-dependent and surface-catalyzed. Gas chromatographic and infrared analysis of polar fractions of stressed and unstressed fuel are virtually identical, indicating that deposit precursors exist at very low levels. (Author)

A81-46478 **Avionics thermal integration for the Boeing 767 airplane.** R. L. Slack and A. J. P. Lloyd (Boeing Commercial Airplane Co., Renton, WA). In: Life cycle problems and environmental technology; Proceedings of the Twenty-sixth Annual Technical Meeting, Philadelphia, PA, May 12-14, 1980. Mt. Prospect, IL, Institute of Environmental Sciences, 1980, p. 11-18.

With reference to Boeing aircraft B-747 and B-767, methods used to improve avionic reliability and reduce maintenance costs by lowering component operating temperatures are discussed. Attention is given to the following cooling concepts: (1) avionic cooling air exhausted overboard after cooling avionics; (2) avionic cooling air recooled using ram air; (3) avionic cooling air recooled using air conditioning system; and (4) avionic cooling air recooled using skin heat exchanger. A prototype avionic cooling system for the B-767 which employs a skin heat exchanger is presented. V.L.

A81-46480 # **Aircraft/avionics environmental integration program.** P. Hermes and J. Wafford (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH). In: Life cycle problems and environmental technology; Proceedings of the Twenty-sixth Annual Technical Meeting, Philadelphia, PA, May 12-14, 1980. Mt. Prospect, IL, Institute of Environmental Sciences, 1980, p. 23-27.

Activities of USAF/Aeronautical Systems Division related to aircraft/avionics environmental integration are reviewed with emphasis on specifications and standards being developed to assist in acquiring equipments and systems in a cost effective manner. The primary purposes of these documents are: (1) to introduce new analyses and tradeoff studies in the early development phases; (2) to provide a contractual basis for informal activities previously accomplished by the contractors; and (3) to replace or supplement universal requirements with engineering approaches tailored to specific applications. V.L.

A81-46483 **Developing test profiles for multiple mission situations.** A. Dantowitz (Grumman Aerospace Corp., Bethpage, NY). In: Life cycle problems and environmental technology; Proceedings of the Twenty-sixth Annual Technical Meeting, Philadelphia, PA, May 12-14, 1980. Mt. Prospect, IL, Institute of Environmental Sciences, 1980, p. 49-51. Contract No. N00014-77-C-0662.

A methodology is presented for establishing environmental test profiles for multimission situations. Various approaches are considered, and a composite test profile approach is recommended. It is suggested that the method outlined in MIL-STD-781C for selecting vibration levels can adequately serve as a basis for determining all environmental levels. F.G.M.

A81-46491 The Hornet's operational mission environment. R. D. Dighton and T. P. Thomas (McDonnell Aircraft Co., St. Louis, MO). In: Life cycle problems and environmental technology; Proceedings of the Twenty-sixth Annual Technical Meeting, Philadelphia, PA, May 12-14, 1980. Mt. Prospect, IL, Institute of Environmental Sciences, 1980, p. 113-116.

Environmental testing requirements for the avionic equipment of the F/A-18 Hornet naval strike fighter in the areas of temperature, vibration, and moisture are compared with the traditional MIL-STD-781B requirements. The methods used to establish the Hornet's operational mission environment (OME) are reviewed. The missions and flight regime of the multimission Navy and Marine strike fighter are described, and differences between the OME approach and the conventional MIL-STD-781B specifications are examined. Accelerated testing techniques are discussed, along with thermal testing and combined testing environments with respect to vibration and nonoperational ground environment. The expected life-cycle cost savings of OME design and testing of 20 major pieces of Hornet avionic equipment is estimated to be $108 million. F.G.M.

A81-46537 Parameter estimation of an SSR amplitude comparison monopulse extractor. G. Jacovitti (Roma, Università, Rome, Italy). *Electronics Letters,* vol. 17, Sept. 3, 1981, p. 632, 633.

The results of an investigation concerning the monopulse receiver used by the ADSEL (selectively addressed secondary radar system) are summarized. The results characterize the bias and the variance of the error as a function of boresight angle and the mismatching of channels. It is concluded that the relative phase shift does not have a significant effect on the accuracy of measurement in practical cases, and that estimation bias is negligible. O.C.

A81-46575 Airport catchment areas and air passenger demand. O. E. Moore (British West Indian Airways, Ltd., Port of Spain, Trinidad and Tobago) and A. H. Soliman. *ASCE, Transportation Engineering Journal,* vol. 107, Sept. 1981, p. 569-579. 14 refs. Research supported by the Natural Sciences and Engineering Research Council of Canada and University of Manitoba.

It is sought to construct suitable econometric models to explain variations in air travel demand among several area pairs in a given year, in terms of known factors characteristic of each pair. Special attention is given to the development of suitable demand functions enabling past and present passenger trip profiles to be expressed quantitatively in terms of such variables as populations, indicators of socioeconomic activity, and measures of air service. Where applicable, use is also made of combined cross-sectional and time series information in an attempt to improve the quality of the conclusions drawn. The independent variables used in the demand function developed for air travel in the market area are population, incomes, air fares, and empirically derived community-of-interest or attractivity measures. C.R.

A81-46603 American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981. 558 p. Members, $55.; nonmembers, $80.

The topics considered are related to aerodynamics, aircraft design, avionics and systems, dynamics handling qualities, manufacturing and product assurance, propulsion, structures and materials, test and evaluation, and acoustics. Attention is given to the prediction of dynamic stall and unsteady airloads for rotor blades, the active elimination of stall conditions, an optimization theory applied to higher harmonic control of circulation controlled rotors, helicopter airflow and wake characteristics for low speed and hovering flight from rocket interference investigations, an evaluation of advanced rotorcraft configurations for emerging military applications, computer aided helicopter design, fiber optic technology for data transmission in the helicopter environment, an electronic master monitor and advisory display system, the determination of in-flight helicopter loads, a unified approach to the optimal design of adaptive and gain scheduled controllers to achieve minimum helicopter rotor vibration, the nonlinear dynamic characteristics of the rotor bifilar absorber, the impact on helicopter cockpits of integrated advanced flight controls and avionics, factors influencing the selection of tooling and fabrication methods in building a composite fuselage, future challenges in helicopter flight/propulsion control integration, advanced transmission component development, and the variable stress ratio fatigue strength curve. G.R.

A81-46604 # Prediction of dynamic stall and unsteady airloads for rotor blades. S. T. Gangwani (United Technologies Research Center, East Hartford, CT). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 1-17. 12 refs. Research sponsored by the United Technologies Corp.

A detailed study of the wind tunnel test data of oscillating airfoils has led to a relatively simple formulation, involving a compact set of dynamic parameters, which accurately predicts the unsteady aerodynamic coefficients of airfoils during dynamic stall. One of the main features of the formulation is that it adequately accounts for the effects of the formation and streamwise movement of the vortex shed from the airfoil leading edge during dynamic stall. Based upon this formulation, a new method has been developed that determines the unsteady aerodynamic loading acting on rotor blades operating in stall. The effects of the azimuthal variation in aerodynamic sweep angle and Mach number are appropriately incorporated in the method. The synthesized unsteady lift and pitching moment hysteresis loops match very well with the two-dimensional test data. The results of a limited correlation study involving the application of the present method to full scale helicopter rotor blades indicate improved correlation between analytical predictions and the test data. (Author)

A81-46605 # Active elimination of stall conditions. M. Kretz (Giravions Dorand Industries, Suresnes, Hauts-de-Seine, France). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 18-25. 15 refs.

Procedures for an active control of stall conditions are considered. It appears that an approach based on direct blade pitch variations constitutes the simplest solution with respect to the current state of the art. A description is presented of tests in which this approach was used to control pitch by feedback based on the observation of the pressure coefficient. Attention is given to 2-D tests and F-rotor tests. The feasibility of active elimination of stall conditions could be experimentally demonstrated on a 6-foot rotor. A stall barrier feedback method involving the use of two distinct analog loops was employed in the experiment. The presence of unsteady forces acting on the airfoil was detected with the aid of local pressure sensors. G.R.

A81-46606 # Optimization theory applied to higher harmonic control of circulation controlled rotors. J. Abramson and E. O. Rogers (U.S. Naval Material Command, David W. Taylor Ship Research and Development Center, Bethesda, MD). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 26-36.

The feasibility of using numerical optimization techniques to determine control inputs to a high speed rotor system employing circulation control aerodynamics was investigated. The objective was to determine the azimuthal loading distribution (cyclic pressure waveform) which would be optimum with respect to performance parameters such as compressor power, mass flow, or peak cyclic pressure. An optimization code, COPES/CONMIN, is coupled with an empirically derived model of the rotor based on cyclic control perturbation derivatives. For specific flight conditions, solutions were obtained for optimum cyclic waveforms. These control inputs were experimentally verified, producing up to a 20 percent reduction in compressor power as compared to the standard one-per-revolution cyclic control. Influences on blade loading are presented along with investigations of blade response to higher harmonic control inputs.

The mathematical concepts and procedures used should be applicable to conventional (unblown) rotors. (Author)

A81-46607 # **The aerodynamic influences of rotor blade airfoils, twist, taper and solidity on hover and forward flight performance.** G. J. Bingham (U.S. Army, Research and Technology Laboratories, Hampton, VA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 37-50. 12 refs.

The influences of rotor blade planform, twist, and airfoils on hover and forward flight performance are reviewed. Although the design philosophy described can be considered to be general in nature, the analysis presented is related to a UH-1 type helicopter. The results show that the radial position of the initiation of taper and taper ratio can have a significant influence on the efficiency of a rotor in both hover and forward flight. The influence of these two parameters decreases as blade solidity is increased. The influence of linear twist varies with location of taper initiation and taper ratio. It is observed that the blade planform, twist, and airfoils should be considered simultaneously on the basis of the lift coefficient-Mach number requirements for a given configuration. Design considerations such as autorotation characteristics and aircraft maneuvers must be considered also but are not addressed herein. However, the latter can be considered within the same context as the forward flight lift coefficient-Mach number operating conditions. (Author)

A81-46608 # **Helicopter airflow and wake characteristics for low speed and hovering flight from rocket interference investigations.** A. J. Landgrebe, R. B. Taylor, T. A. Egolf, and J. C. Bennett (United Technologies Research Center, East Hartford, CT). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, *Proceedings*. Washington, DC, American Helicopter Society, 1981, p. 51-65. 10 refs.

The flow field induced by the rotor wake system of a helicopter can have a significant effect on the trajectory of a rocket fired from the helicopter. The shortage of information on helicopter airflow and its influence on free flight rockets is, in this connection, a current concern of the Army. The considered investigation has the objective to show that the combined use of laser velocimetry, flow visualization, and computerized wake and airflow analyses can be applied to acquire an improved understanding of the aerodynamics of low speed flight. Experimental and analytical techniques employed in a number of studies are discussed, taking into account test facilities and model, test configurations and conditions, flow visualization, laser velocimetry, wake and airflow analyses, and rotor wake characteristics. Airflow velocity characteristics are examined, and attention is given to the influence of fuselage, gross weight, ground, and flight direction on the rocket trajectory. G.R.

A81-46609 # **Safety - A prime factor in the design of Aérospatiales Super-Puma AS 332.** E. Lefort (Société Nationale Industrielle Aérospatiale, Division Hélicoptères, Marignane, Bouches-du-Rhône, France). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 66-71.

In designing the Super Puma it was attempted to utilize the in-flight experience made with Puma helicopters. Factors which confer a high safety level on the Super Puma are related to its engine power, the fail-safe characteristics of the composite material components of its main and tail rotors, the redundancy of almost all circuits and systems, the almost infinite life of the main transmission assemblies, and the properties of the aircraft structure, the landing gear, the floor, and the seats. The Super Puma is equipped with an engine failure detection system. The helicopter is an aircraft with an all-weather capability. Anti-icing protection characteristics include a capability to detect icing conditions by means of the weather radar located in the radome. The aircraft can continue its mission on one engine should the other engine become inoperative. G.R.

A81-46610 * # **An ABC status report.** A. W. Linden and A. J. Ruddell (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 72-87. 19 refs. Army-Navy-NASA-supported research.

The Advancing Blade Concept (ABC) uses two rigid counter-rotating rotors in a coaxial arrangement to provide advancing blades on both sides of the aircraft. This makes use of the high dynamic pressure on the advancing side of the rotors at high forward speed, virtually ignoring the low dynamic pressure on the retreating side, while still keeping the rotor system in roll trim. Theoretically such a rotor system will maintain its lift potential as speed increases. The XH-59A was designed to investigate this theory. A description is provided of the flight test program from May, 1980 to January, 1981. A summary is presented of the knowledge gained throughout the entire program, and current pitfalls are reviewed. It is concluded that the ABC has been verified, with the XH-59A envelope of blade lift coefficient as a function of advance ratio greatly exceeding that of conventional helicopter rotor systems. G.R.

A81-46611 # **An evaluation of advanced rotorcraft configurations for emerging military applications.** R. K. Wernicke and J. N. Fischer (Bell Helicopter Textron, Fort Worth, TX). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, *Proceedings*. Washington, DC, American Helicopter Society, 1981, p. 88-96.

In the considered studies, three advanced rotorcraft designs were developed to meet the Marine assault transport mission requirements, including a pure helicopter configuration and two configurations providing cruise speeds greater than that possible with a pure helicopter. In the evaluation, the helicopter is found to be the least complex aircraft with the lowest design gross weight. It is competitive for short range missions. However, it has the slowest speed and is not practical for self-deployment. The compound helicopter is more complex and has the highest design gross weight. The design is compact and it can reach high dash speeds. Long range cruise speed is only slightly better than that of the helicopter. The tiltrotor aircraft productivity is the highest from relatively short ranges out to very long ranges. Its cruise fuel efficiency, altitude performance, and self-deployability are characteristics that are becoming increasingly important in today's changing international situations. G.R.

A81-46612 # **Late 80's advanced rotary wing aircraft potential based on ATDE, ACAP, and ITR.** J. W. White (U.S. Army, *Applied Technology Laboratory, Fort Eustis, VA*). *In: American* Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 97-111. 16 refs.

Attention is given to the 800 Horsepower Advanced Technology Demonstrator Engine (ATDE), the Advanced Composite Airframe Program (ACAP), and the Integrated Technology Rotor (ITR) Program. The integration of these technologies into an advanced helicopter design during the late 80's offers significant improvements in military and commercial operational envelopes, productivity, and fuel economy. Two additional Army advanced development programs are related to the Advanced Digital Optical Control System (ADOCS) and the Helicopter Adverse Weather Fire Control/Acquisition Radar (HAWFCAR). It is found that technology currently underway or planned provides options for future 7-10,000 pound gross weight aircraft with 50 percent improvement in productivity based on fuel usage while providing significant improvements in damage tolerance and crashworthiness. Two parametric aircraft designs are presented, including a medium utility helicopter and an attack helicopter. G.R.

A81-46613 # **Computer aided helicopter design.** H. J. Rosenstein and K. A. Stanzione (Boeing Vertol Co., Philadelphia, PA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 112-127.

This paper describes the formulation of the HElicopter Sizing and Performance COMputer Program (HESCOMP) which is used as an analytical tool in the preliminary design process. The program integrates aircraft configuration sizing, performance aerodynamics and weights into a multidisciplinary rotary wing design tool which is ideally suited to rapidly perform comparative configuration design studies. To illustrate the HESCOMP capabilities, the program was used in the conceptual design study of an advanced military transport for introduction in the late 1980's. The purpose of this

study was to compare on an equal basis the size and performance of a single and tandem rotor helicopter designed for a typical long range military transport mission. When designed for equal spotting factor (minimum folded size) and compared on the basis of gross weight the tandem rotor helicopter is approximately 4% lighter. (Author)

A81-46614 # **Fiber optic technology for data transmission in the helicopter environment.** J. C. Wyatt, F. B. Snyder, and R. R. Giri (Harris Corp., Melbourne, FL). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 128-142. 7 refs.

An optical fiber medium offers broad bandwidth capabilities and is inherently immune to electromagnetic interference/radio frequency interference and electromagnetic pulse effect generated by both lightning and, for military applications, nuclear events. The considered investigation is concerned with the implementations of dedicated point-to-point and multiplexed data buses using both wire and optical fiber interconnects. A system architecture for a helicopter fly-by-light multiplex system is presented, and the reliability of various fiber-optic system configurations is discussed. It is pointed out that improvements in technology will have positive impact on fiber-optic flight control systems within future avionic platforms. Operational and evolutionary improvements in fiber-optic components are expected along with the development of optical servovalves and transducers, and a relative cost reduction in fiber-optic components. G.R.

A81-46615 # **Electronic Master Monitor and Advisory Display System.** R. V. Kurowsky (U.S. Army, Avionics Research and Development Activity, Fort Monmouth, NJ) and R. C. McLane (General Electric Co., Pittsfield, MA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 143-152. 12 refs. Grant No. DAAK80-79-C-0270.

An Electronic Master Monitor and Advisory Display System (EMMADS) is designed around the requirements of the CH-47 helicopter with the intent of automating the crew's monitoring of the basic aircraft subsystems. The objective of the reported investigation is the feasibility demonstration of a direct view flat panel technology (electroluminescent) display controlled by digital logic with integrated, programmable operator controls. The system design goal is to relieve the crew of routine 'housekeeping' tasks. The Human Engineering Program which supported the EMMADS design is considered, taking into account an information requirements analysis, a pilot evaluation, testing, control/display design criteria, and display formats. Beginning in mid-1981, the flight test phase of EMMADS will commence with further Human Engineering activity. G.R.

A81-46617 # **CH-53 Helicopter Night Vision System simulation experiments.** G. W. Mowery, R. J. Milelli (Martin Marietta Aerospace, Orlando, FL), L. B. McDonald (McDonald and Associates, Inc., Orlando, FL), C. Pontelandolfo (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA), and P. Noggle (U.S. Navy, Naval Air Systems Command, Washington, DC). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 163-178.

A Helicopter Night Vision Program has been undertaken to improve the low altitude night operational and reduced visibility capability of the Marine assault transport helicopter force. The Helicopter Night Vision Program is challenged with defining a Helicopter Night Vision System (HNVS) capable of being retrofitted into the transport helicopter force at the lowest possible cost, and with the highest possible performance characteristics. After a comparative examination it was concluded that forward looking infrared (FLIR) devices will perform better than other electro-optical systems. Consequently a FLIR system was selected for the assault transport helicopter. The HNVS simulation experiment is discussed. It was found that pilots can maneuver under 100 feet above ground level and between 60 to 80 knots in the night assault transport mission with a panel mounted display, gimballed sensor, and Doppler navigation. G.R.

A81-46618 # **Determination of in-flight helicopter loads.** N. Giansante, R. Jones (Kaman Aerospace Corp., Bloomfield, CT), and N. J. Calapodas (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 179-187.

Results of tests on an AH-1G helicopter show that external vibratory forces, such as those of the main and tail rotors, acting on a helicopter in flight can be determined accurately from accelerometer measurements on the fuselage only. The methodology which is called Force Determination requires accelerations measured on the airframe in flight and a calibration matrix measured during ground vibration tests. The elements of the calibration matrix are partial derivatives relating acceleration at coordinate i to force at coordinate j on the airframe. The magnitudes and phases of the external forces acting on the aircraft in flight are obtained from the flight accelerations and the calibration matrix. (Author)

A81-46619 # **A unified approach to the optimal design of adaptive and gain scheduled controllers to achieve minimum helicopter rotor vibration.** J. A. Molusis (Connecticut, University, Storrs, CT), C. E. Hammond (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA), and J. H. Cline (U.S. Army, Structures Laboratory, Hampton, VA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 188-203. 15 refs.

Attention is given to stochastic control theory, aspects of cautious control algorithm development, the advantages of adaptive controllers, the linear quadratic Gaussian controller, the perturbation controller, a proportional-integral controller, a combination adaptive/gain scheduled controller, aspects of controller testing, the application of adaptive control algorithms, the application of gain scheduled controllers, and vibration reduction results. Six different control laws are developed. Four of them are implemented and evaluated in the Langley Transonic Dynamics wind tunnel. The obtained results provide the means for using control design to achieve theoretically minimum rotor vibration throughout the flight envelope. G.R.

A81-46620 * # **Full-scale wind-tunnel test of the aeroelastic stability of a bearingless main rotor.** W. Warmbrodt, J. McCloud, III (NASA, Ames Research Center, Moffett Field, CA), M. Sheffler, and J. Staley (Boeing Vertol Co., Philadelphia, PA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 204-216. 12 refs.

The rotor studied in the wind tunnel had previously been flight tested on a BO-105 helicopter. The investigation was conducted to determine the rotor's aeroelastic stability characteristics in hover and at airspeeds up to 143 knots. These characteristics are compared with those obtained from whirl-tower and flight tests and predictions from a digital computer simulation. It was found that the rotor was stable for all conditions tested. At constant tip speed, shaft angle, and airspeed, stability increases with blade collective pitch setting. No significant change in system damping occurred that was attributable to frequency coalescence between the rotor inplane regressing mode and the support modes. Stability levels determined in the wind tunnel were of the same magnitude and yielded the same trends as data obtained from whirl-tower and flight tests. G.R.

A81-46621 # **Helicopter trim by periodic shooting with Newton-Raphson iteration.** D. A. Peters (Washington University, St. Louis, MO) and A. P. Izadpanah. In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 217-226. 9 refs. Grants No. DAAG29-77-G-0103; No. DAAG29-80-C-0092.

The problem of finding a rotor trim solution involves both a search for the correct control settings that will give a desired flight condition as well as the calculation of the periodic solution to the nonlinear rotor equations, given those controls. In the present study, a method is developed whereby the correct controls and periodic solution (i.e., the correct blade initial conditions to yield periodicity) are found simultaneously. The use of initial conditions as unknown variables to obtain periodicity is not new and has been called

'periodic shooting'. The simultaneous solution of the controls and initial conditions, however, is an innovation developed here. Analysis shows that the new method is computationally superior to other methods in many practical applications. Numerical implementation on nonlinear flap-lag equations verifies the usefulness of the method even under extreme conditions such as instability, resonance, and high advance ratio. A detailed study of the convergence shows that the method may diverge for certain combinations of initial guesses, but that the divergence can be circumvented by simple procedures. (Author)

A81-46622 # **Nonlinear dynamic characteristics of the rotor bifilar absorber.** W.-L. Miao and T. Mouzakis (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 227-236. Army-supported research.

A coupled rotor/bifilar/airframe analysis has been developed under contract to the U.S. Army Structures Lab (AVRADCOM). This analysis has been used to study the dynamic characteristics of the centrifugally tuned, rotor-hub-mounted, bifilar vibration absorber. The performance of the bifilar absorber is shown to be a function of its basic design parameters: dynamic mass, damping and tuning. Since the absorber acts to reduce the motion of its attachment point to the main rotor hub, hub impedance is of equal importance. For the case of a bifilar absorber which reacts cyclic response (e.g., 3/rev rotating response on a four-bladed rotor), the degree of symmetry of hub impedance in the two orthogonal directions also influences absorber effectivity. Because of manufacturing tolerances, every individual bifilar mass can be slightly different from the others in terms of its basic parameters. Results are presented which show the cause of dissimilar bifilar mass motions and the resulting non-N/rev excitation of the airframe. Flight test results for the Black Hawk helicopter which demonstrate the key results from the analysis and their correlation are also presented. (Author)

A81-46623 * # **A flight investigation of static stability, control augmentation, and flight director influences on helicopter IFR handling qualities.** J. V. Lebacqz, J. M. Weber (NASA, Ames Research Center, Moffett Field, CA), and L. D. Corliss (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 237-251. 15 refs.

A flight experiment was conducted using the NASA-Army V/STOLAND UH-1H variable-stability helicopter to investigate the influence of several longitudinal-static-stability, control-augmentation, and flight-director parameters on helicopter flying qualities during terminal area operations in instrument conditions. This experiment, which was part of a joint NASA/FAA program pertaining to helicopter IFR airworthiness, was designed to corroborate and extend previous ground simulation results obtained in this program. Variations examined included stable and neutral longitudinal control position gradients, rate-damping and attitude-command augmentation, and raw data versus flight-director displays. Pilot rating results agreed excellently with the ground simulation data, indicating an adequate instrument capability with rate-damping augmentation and neutral statics and the need for pitch-roll attitude augmentation to achieve a satisfactory system. (Author)

A81-46624 # **The impact on helicopter cockpits of integrated advanced flight controls, avionics and optics.** E. D. Diamond and J. R. Maciolek (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 252-262.

It appears that existing cockpits will be inadequate for performance of anticipated future helicopter missions. Further proliferation of discrete mission related equipment in the cockpit will not solve the problem. A new approach is, therefore, required. Pilot productivity has to be increased by controlling workload and reducing fatigue for a given mission. Pilot productivity, in this connection, means that the pilot can perform the anticipated ing and inspection principles with an examination of the main advantages obtained. The development methodology for composite material components is discussed, with attention given to the theoretical forecast, dimensioning criteria, fabrication methods, quality control, and certification. C.R.

A81-46725 **Survivors on the RPV front.** D. Chopping. *Interavia,* vol. 36, Sept. 1981, p. 898, 899.

A review is made of current remotely piloted vehicle (RPV) system development programs. Among the aircraft discussed are: (1) the CL-289, which is intended to replace the existing CL-89 battlefield surveillance system while meeting the needs of an army corps, rather than only a division; (2) the CL-227 short-range RPV, for brigade use; (3) the Mirach 100, which may be launched either from ground vehicles or helicopters; (4) the IAI Scout, which has already been proven in combat in the middle east; (5) the Argus, a tethered rotary-wing surveillance platform; (6) the MTC II, a mini-helicopter employing two contra-rotating, three-bladed rotors; and (7) the Aquila, which incorporates such advanced 'stealth' technology features as a shrouded rotor, Kevlar/plastic composite construction and blended wing/body planform. O.C.

A81-46626 # **A preliminary flight investigation of cross-coupling and lateral damping for nap-of-the-earth helicopter operations.** L. D. Corliss and G. D. Carico (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 276-287. 9 refs.

A helicopter in-flight simulation was conducted to look at the effects of variations in roll damping, roll sensitivity, and pitch and roll rate cross-coupling on helicopter flying qualities for NOE operations. The experiment utilized the Ames UH-1H helicopter in-flight simulator, which is equipped with the V/STOLAND avionics system. The response envelope of this vehicle allowed for the simulation of configurations in the low-to-moderate damping and sensitivity range. A visual, low-level slalom course was set up, using the 1000-ft markers of an 8000-ft runway to evaluate the various configurations. Test results are shown in terms of Cooper-Harper pilot ratings. These results show good consistency with previous ground simulator results and with some elements of flying qualities criteria, such as those of MIL-F-83300 and MIL-H-8501A. (Author)

A81-46627 # **Handling qualities of the SH-60B Seahawk.** I. Alansky, R. Faull, and J. Skonieczny (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 288-306.

A review is provided of the flying qualities, the automatic flight control system, and the developmental testing of the U.S. Navy's most advanced helicopter. Primary mission of the SH-60B Seahawk are related to anti-submarine warfare and anti-ship surveillance and targeting. Its secondary missions include search and rescue, communications relay, medical evaluation, and vertical replenishment. The operational considerations for the SH-60B helicopter require that these missions be performed from nonaviation type ships in conditions reaching upper sea-state 5. An examination is conducted of the primary differences between the Seahawk and the UH-60A Black Hawk. The differences result primarily from the Light Airborne Multi-Purpose Systems (LAMPS) MK III mission requirements. Handling qualities design considerations are discussed, taking into account the aerodynamic effects of mission equipment, a SH-60B simulation math model, control requirements, static stability characteristics, shipboard landings, and hydrodynamic stability considerations. G.R.

A81-46628 # **Factors influencing the selection of tooling and fabrication methods in building a composite fuselage.** J. J. Barto, Jr. (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings.
Washington, DC, American Helicopter Society, 1981, p. 307-315. Grant No. DAAK51-80-C-0001.

A description is presented of the development and fabrication methods selected in the construction of large advanced composite laminating molds for helicopter fuselage structures, taking into

account investigations related to the conversion of the rear fuselage of the UH-60A Black Hawk helicopter to composite construction. Fabrication of the rear fuselage is highly labor intensive and amenable to cost reduction by conversion to molded composite construction. The composite structure is anticipated to be 10% lighter and 35% lower in unit cost than current metal counterparts. Design to cost producibility studies, and risk reduction trials have been conducted. These investigations have provided tooling and manufacturing concepts for cost effective processes and economical tooling. G.R.

A81-46629 # **Manufacturing methods for a composite main rotor blade for the YAH-64 helicopter.** R. L. Kiraly (Hughes Helicopters, Inc., Culver City, CA) and J. Tutka (U.S. Army Aviation Research and Development Command, St. Louis, MO). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 316-321.

This paper describes the manufacturing methods utilized in the fabrication technique associated with the wet filament winding (WFW) cocure process for the Advanced Attack Helicopter YAH-64 composite main rotor-blade. This new technology method is a result of the experience gained with the development of multitubular spar main rotor blades for the AH-1G aircraft and NASA wind tunnel test blades. The WFW cocure process eliminates a major portion of the hand labor encountered with conventional wet lay-up composite structures by substituting machine assembly techniques, thereby making its assembly simpler without sacrificing structural integrity. (Author)

A81-46632 # **Waterjet trimming of cured composites.** S. E. Kosturak (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 332-343.

In the case of Kevlar/epoxy, a composite material widely used in aircraft structures, experience has shown that conventional machining methods do not produce acceptable results. The edges of the Kevlar are left in a fuzzy condition and require hand sanding. The sanding is labor consuming, costly, and produces critical dust problems. To eliminate cutting associated problems, an investigation was conducted concerning the employment of a high pressure waterjet cutting system for trimming cured Kevlar composites. The process does not create dust hazards and it minimizes the need for expensive exhaust systems. In addition, waterjet cutting offers the potential of significantly increased cutting rates, enhanced edge quality, and low noise levels. The introduction of waterjet cutting made it possible to reduce the trimming man-hours per piece by 75%. G.R.

A81-46633 # **Future challenges in helicopter flight/propulsion control integration.** L. D. Emerson, Jr. (United Technologies Corp., Pratt and Whitney Aircraft Div., West Palm Beach, FL). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 344-348.

It is noted that digital electronic systems have reached adequate maturity to allow their use for critical flight control functions, including propulsion control. It is thought that helicopter operational suitability and mission reliability can be improved through proper integration of electronic systems. The challenge posed by an advanced helicopter flight and propulsion control system is discussed, as is an approach to developing the technology needed to assure maximum flight safety and operational effectiveness with a reasonable ownership cost. C.R.

A81-46634 # **Advanced transmission component development.** K. M. Rosen and H. K. Frint (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 349-364. 8 refs.

Gearbox design concepts are discussed that permit high temperature operation at increased speeds without degrading strength or weight goals. One approach, which shows promising strength and weight advantages, is high contact ratio gearing. Since the means taken to obtain a high contact ratio tend to produce an inherently weaker tooth, it is noted that reliance must be placed on the multiple load-sharing feature of this design to achieve an advantage over low contact ratio gears. The considerations which must be addressed in the design stage to achieve optimum results are discussed. Two UH-60A helicopter main transmission housings fabricated from a stainless steel alloy (to replace the conventional magnesium alloy casing) are described. Design details and fabrication methods are discussed. C.R.

A81-46636 # **HH-65A Dolphin engine condition monitoring system.** K. K. Ehlers (Aerospatiale Helicopter Corp., Grand Prairie, TX). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 386-394.

The approach to engine condition monitoring incorporated into the Coast Guard's HH-65A Dolphin Short Range Recovery helicopter is discussed. It is noted that this approach requires no dedicated hardware for the Engine Condition Monitoring System (ECMS) but uses hardware which is required for other functions. The five major aircraft subsystems that contribute to the ECMS are described. These are the Sensors, the Mission Computer Unit (MCU), the Control Display Unit (CDU), a caution advisory CDU annunciator, and the Flight Data Storage Unit (FDSU). It is noted that engine data are already available in digital form from the vertical scale electrical optical engine instruments. By means of the ECMS software, the MCU performs the data processing. The flight crew controls the systems using the CDUs, on which the data are displayed. C.R.

A81-46637 # **Projected power and specific fuel consumption development of the Rolls Royce Gem engine.** A. R. Sanderson (Rolls-Royce, Ltd., Aero Engine Div., Watford, Herts., England). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 395-402.

The basic Gem-2 engine rated at 830 SHP for take-off has been in production since 1975. The first stage of uprating, the Gem-41 in service since 1979, gives a 20 percent power increase to 1000 SHP. The paper describes the route proposed for two further steps in the power growth program to circa 1500 SHP and an efficiency improvement program aimed at a 6 percent reduction in SFC at cruise power. (Author)

A81-46638 # **Designing safety into helicopter transmissions.** C. Albrecht (Boeing Vertol Co., Philadelphia, PA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 403-409.

The Boeing Model 234 helicopter is a commercial derivative of the U.S. Army CH-47C helicopter. Although the Chinook has an excellent safety record, features have been incorporated in the 234 that further enhance the design and provide additional safety. Specific items discussed are the use of double-vacuum-melt steels; shotpeening of all critical components; nital etching of all machined and ground surfaces; ultrasonic inspection of the gear steel at the mill; fatigue testing and qualification procedures; overload testing of all the main drive gears and shafting; and auxiliary oil capability. (Author)

A81-46639 # **Some results from a crash energy absorption test for evaluating composite fuselage construction.** R. L. Foye (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA) and W. T. Hodges (U.S. Army, Structures Laboratory, Hampton, VA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 410-418.

Composite cylindrical shell specimens have been crushed in compression as a means of observing and measuring their energy absorption characteristics. These tests have provided a practical basis for comparing various composite construction concepts to aluminum. However, in full scale helicopter drop tests it can be seen that a part of the vehicle kinetic energy is absorbed in skin shear. Therefore, to compare the shear and compression behavior, a

duplicate set of cylindrical specimens were tested in torsion. These tests compared aluminum, fiberglass, Kevlar, and graphite in the form of sandwich and stiffened skin construction. The energy absorption characteristics differed between shear and compression and the results were more complex. However, some of the conclusions from the compression tests remained valid. Namely, sandwich construction absorbed more energy than stiffened skin construction. Aluminum and Kevlar/aluminum hybrid had the highest energy absorption capacity of the stiffened skin specimens. Also, Kevlar and aluminum stiffened skins had superior skin tearing resistance. (Author)

A81-46641 # **Development of composite material helicopter structures.** M. Torres (Société Nationale Industrielle Aérospatiale, Division Hélicoptères, Marignane, Bouches-du-Rhône, France). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 427-436. 7 refs.

The experience with composite materials parts in civil and military aviation is discussed in terms of manufacture, quality control, and operational use. The aircraft Dauphin 2 is discussed in analyzing such composite parts as the rotor assembly (with its Starflex hub and new generation blades), the primary structure components containing carbon, the suspension elements, and the secondary parts involving the use of Kevlar. The description of each component is followed by a presentation of the overall manufacturing and inspection principles with an examination of the main advantages obtained. The development methodology for composite material components is discussed, with attention given to the theoretical forecast, dimensioning criteria, fabrication methods, quality control, and certification. C.R.

A81-46642 # **Helicopter External Gondola System.** J. D. Porterfield (Kaman Aerospace Corp., Bloomfield, CT) and S. G. Riggs, Jr. (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings.
Washington, DC, American Helicopter Society, 1981, p. 437-447. 6 refs.

The design, fabrication, static test, and flight test of the lightweight HEGS-20 module, the newest member of the Army's Helicopter External Gondola System (HEGS), is described. A structural efficiency (structural strength to weight ratio) of 40:1 was made possible through innovative structural concepts and by the use of flexible, high-strength, Kevlar diagonal cables. (Author)

A81-46643 # **An economical approach to automated flight test data reduction.** S. A. Walters (Aerospatiale Helicopter Corp., Grand Prairie, TX). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 448-455.

In connection with the introduction of mini- and microcomputers, it is now economically feasible to acquire a complete computer system, tailored specifically to flight test requirements, to support a single flight test program. The described system offers a number of advantages over the traditional large system approach. First, the flight test department has exclusive use of the system. Second, the system is easily expanded in the event of increased data monitoring requirements by the simple addition of processors in parallel with the current Central Processing Unit. A third advantage of the present system configuration is the ease with which it can be converted for application requiring telemetry of data to the Ground Data Center while the aircraft is in flight. The fourth, and probably biggest advantage of the new approach, is the initial cost of the system. G.R.

A81-46644 * # **Influence of sideslip on the kinematics of the helicopter in steady coordinated turns.** R. T. N. Chen and J. A. Jeske (NASA, Ames Research Center, Moffett Field, CA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 463-477. 16 refs.

A steep coordinated helical turn at extreme angles of attack with inherent sideslip is of primary interest in this study. Unlike fixed-wing aircraft, the helicopter in a steady coordinated turn will inherently sideslip. A set of exact kinematic equations describing this motion in steady helical turns has been developed, and a rational definition for the load factor that best characterizes a coordinated turn for a helicopter has been proposed. An analysis has also been completed on the effects of sideslip on the kinematic relationships in a coordinated turn which is based on new closed-form solutions which relate the aircraft angular rates and pitch and roll attitudes to the turn parameters, angle of attack, and sideslip. The results show that the bank angle of the aircraft can differ markedly from the tilt angle of the normal load factor and that the normal load factor can also differ substantially from the accelerometer reading along the vertical body axis of the aircraft. Generally, sideslip has a strong influence on the pitch attitude and roll rate of the helicopter. The study also indicates that pitch rate is independent of angle of attack in a coordinated turn and that in the absence of sideslip, angular rates about the stability axes are independent of the aerodynamic characteristics of the aircraft. (Author)

A81-46645 # **Reliability and maintainability evaluation of rotor systems.** R. A. Hall (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA) and U. S. Garganese, Jr. (Kaman Aerospace Co., Bloomfield, CT). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 478-483.

The considered study is conducted in connection with an investigation of several advanced rotor systems for helicopters performed by the Army. The study has the objective to develop an evaluation procedure and use it to evaluate eight rotor systems, taking into account the research and development parameters of main rotor systems, which may have either a positive or negative effect on the other systems of the helicopter. The parameters considered include mean time between failure, mean time between removal, maintenance man-hours per flight hour and mean time to repair. The motor systems analyzed are the elastomeric rotor, the bearingless main rotor, the Starflex rotor, the higher harmonic rotor, the circulation control rotor, the reverse velocity rotor, the advancing blade concept rotor, and the Bell-412 rotor. G.R.

A81-46646 * # **A piloted simulation of the backup control system engagement for the YAH-64.** C. L. Blanken, E. W. Aiken, R. K. Merrill (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA), and V. L. Ross (NASA, Ames Research Center, Moffett Field, CA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings.
Washington, DC, American Helicopter Society, 1981, p. 484-492.

A piloted simulator experiment, designed to evaluate and optimize certain backup control system (BUCS) engagement parameters and to provide pilot familiarization with aircraft response prior to flight test of the BUCS in the YAH-64 Advanced Attack Helicopter, is described. Key elements of the simulation were the representation of a control system jam, the pilot's breaking of a shear pin in the jammed control, and the resultant BUCS engagement. To minimize the excursions in aircraft motion which could result from the pilot's control inputs after shear pin breakage, the BUCS control function is blended in gradually. The experiment's results indicate that optimum time to full control authority after shear pin breakage is three seconds in all axes for certain critical tasks. Special pilot training in the recovery from a control system jam may be necessary to minimize unacceptably large aircraft transients in the off-axis. (Author)

A81-46647 # **Helicopter manufacturers economic impact assessment of FAA proposed helicopter certification noise rules /NPRM 79-13/.** R. G. Schlegel (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 503-514. 17 refs.

The NPRM 79-13 was published July 19, 1979 in The Federal Register (Reference 3). Its three provisions are basically concerned with assuring that helicopter noise levels will not exceed the so-called Stage 2 limits. As the result of analyses conducted by the helicopter industry since early 1980, it was concluded that if the rule proceeded as originally proposed by the FAA, that the world helicopter market, which is projected to increase from around 800 million dollars in

1980 to 2.2 billion dollars in the year 2000, in 1980 dollars, would be seriously impacted. It is pointed out that valid noise measurements on the twenty-five helicopters that will be affected by the regulation proposed in NPRM 79-13 are not available. The proposed regulation sets limits that are too low and are incompatible with the capabilities of available technology for predicting and controlling helicopter noise. A regulation at this time is thought to be premature because uncertainty in the actual noise of many affected helicopters prevents a complete analysis of the regulation's economic impact. It is proposed to conduct a joint FAA/NASA/Industry helicopter noise reduction research program. G.R.

A81-46649 # **Prediction of helicopter rotor noise from measured blade surface pressure.** G. P. Succi (Bolt Beranek and Newman, Inc., Cambridge, MA) and J. T. Brieger (Bell Helicopter Textron, Fort Worth, TX). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. Washington, DC, American Helicopter Society, 1981, p. 522-531. 14 refs.

The current techniques of helicopter rotor noise prediction attempt to describe the details of the noise field precisely and remove the empiricisms and restrictions inherent in previous methods. These techniques require detailed inputs of the rotor geometry, operating conditions, and blade surface pressure distribution. The purpose of this paper is to review those techniques in general and the Farassat/Nystrom analysis in particular. The predictions of the Farassat/Nystrom noise computer program, using both measured and calculated blade surface pressure data, are compared to measured noise level data. This study is based on a contract from NASA to Bolt Beranek and Newman Inc. (BBN) with measured data from the AH-IG Helicopter Operational Loads Survey flight test program supplied by Bell Helicopter Textron. (Author)

A81-46714 **Soviet military air cushion vehicles - Mechanized amphibious assault.** J. S. Dibbern (U.S. Army, Foreign Science and Technology Center, Batesville, VA). In: Canadian Symposium on Air Cushion Technology, 14th, Ottawa, Canada, September 22-24, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1980, p. 173-185.

An assessment is given of the technological sophistication, operational capabilities, performance characteristics and military significance of three air cushion vehicle (ACV) classes currently deployed by the Soviet Union in its amphibious warfare forces. The classes are: (1) the 27,000-kg GUS class, which can carry a platoon of troops at up to 90 km/hr and is equipped for all-weather operation; (2) the AIST class, which with its 270,000 kg maximum weight can carry two medium tanks and large numbers of motorized infantry; and (3) the most recently launched, LEBED class, of 120,000 kg, which strongly resembles the U.S. Navy's projected JEFF-B amphibious assault landing craft. It is concluded that the significance of these designs does not lie in their technological sophistication so much as in the fact that they are already operational and accumulating valuable experience. O.C.

A81-46725 **Survivors on the RPV front.** D. Chopping. *Interavia,* vol. 36, Sept. 1981, p. 898, 899.

A review is made of current remotely piloted vehicle (RPV) system development programs. Among the aircraft discussed are: (1) the CL-289, which is intended to replace the existing CL-89 battlefield surveillance system while meeting the needs of an army corps, rather than only a division; (2) the CL-227 short-range RPV, for brigade use; (3) the Mirach 100, which may be launched either from ground vehicles or helicopters; (4) the IAI Scout, which has already been proven in combat in the middle east; (5) the Argus, a tethered rotary-wing surveillance platform; (6) the MTC II, a mini-helicopter employing two contra-rotating, three-bladed rotors; and (7) the Aquila, which incorporates such advanced 'stealth' technology features as a shrouded rotor, Kevlar/plastic composite construction and blended wing/body planform. O.C.

A81-46749 **Inverse problems of guided-flight dynamics - Longitudinal motion.** B. N. Petrov and P. D. Krut'ko (Moskovskoe Vysshee Tekhnicheskoe Uchilishche, Moscow, USSR). *(Akademiia Nauk SSSR, Doklady,* vol. 255, no. 1, 1980, p. 43-47.) *Soviet Physics - Doklady,* vol. 25, Nov. 1980, p. 895-897. Translation.

The paper deals with the development of a new approach to the construction of aircraft control algorithms. The approach is based essentially on the concept of inverse problems of dynamics, introduced by Petrov, Krut'ko, and Popov (1979). The basic aspects of automatic aircraft control are analyzed on the basis of a nonlinear mathematical model whose equations are written in a system of velocity coordinates. V.P.

A81-46782 **Local approximation of a vortex layer by a system of discrete vortices.** D. N. Gorelov. *(PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Sept.-Oct. 1980, p. 76-82.) *Journal of Applied Mechanics and Technical Physics,* vol. 21, no. 5, Mar. 1981, p. 638-643. 9 refs. Translation.

It is shown that the system of discrete vortices can approximate the velocity induced by a continuous eddy layer including the points in the layer in the vicinity of its ends. Expressions are derived for determining the coordinates of these points which take into account the local velocity field near the eddy layer. A.T.

A81-46783 **Automatic damping of vibrations of an airplane wing by internal control forces.** V. I. Merkulov. *(PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Sept.-Oct. 1980, p. 91-99.) *Journal of Applied Mechanics and Technical Physics,* vol. 21, no. 5, Mar. 1981, p. 650-656. Translation.

Various methods of damping elastic vibrations in aircraft wings include automatic control of amplitude, frequency, and phase of the acting forces. Weight shifting, internal tension, flexible shafts, and gyrometers were examined as controlling elements; these methods are effective in airport operations where aircraft is subjected to maximum dynamic loads. A.T.

A81-46813 # **Use of carbon composites in aircraft structures (Primenenie ugleplastikov v konstruktsii letatel'nykh apparatov).** Iu. N. Rabotnov, A. A. Tupolev, V. F. Kut'inov, V. P. Kogaev, A. V. Berezin, and V. V. Sulimenkov. *(Vsesoiuznaia Konferentsiia po Mekhanike Polimernykh i Kompozitnykh Materialov, 4th, Riga, Latvian SSR, Oct. 1980.) Mekhanika Kompozitnykh Materialov,* July-Aug. 1981, p. 657-667. 33 refs. In Russian.

Methods for calculating deformation and strength characteristics of laminated composites are reviewed with reference to the results of static, dynamic, and fatigue testing of carbon composites with various ply patterns. A method for calculating additional safety factors is proposed along with a standardized finite-element procedure for calculating the stress-strain state of composite control surface structures. Examples illustrating application of the proposed method are presented. V.L.

A81-46794 # **Electric installation work on aircraft (Elektromontazhnye raboty na letatel'nykh apparatakh).** A. V. Chernyshev, N. I. Tsibizov, and B. V. Boitsov. Moscow, Izdatel'stvo Mashinostroenie, 1980. 240 p. 5 refs. In Russian.

The book contains basic information on methods used in installing the electric equipment of aircraft with emphasis on wiring techniques. Consideration is given to the most common and time-consuming installation, control, and test procedures. The design and operation of recommended tools and devices are examined. Finally, safety techniques are discussed. V.L.

A81-46847 # **Self-oscillations of a wheel on a self-aligning landing gear strut with a nonlinear damper (Avtokolebaniia kolesa na orientiruiushcheisia stoike shassi s nelineinym dempferom).** L. G. Lobas. *Prikladnaia Matematika i Mekhanika,* vol. 45, July-Aug. 1981, p. 756-759. In Russian.

An asymptotic method is used to determine the amplitude and frequency of self-oscillations of a wheel on a self-aligning landing-gear strut subjected to flexural strain. The strut has a square-law damper developing turbulent resistance and connected in parallel with an elastic element. The obtained solution makes it possible to control the wheel shimmy amplitude by selecting an appropriate damping coefficient for the square-law damper. V.L.

A81-46848 # **Erosion strength of aircraft engine and power plant parts (Erozionnaia prochnost' detalei dvigatelei i energoustanovok letatel'nykh apparatov).** R. G. Perel'man. Moscow, Izdatel'stvo Mashinostroenie, 1980. 247 p. 225 refs. In Russian.

Erosion due to high-velocity interaction between liquid particles and a solid is discussed from the theoretical and engineering points of view. Computer algorithms for calculating erosion of the blades of gas turbine engines and space power plants as well as methods for designing parts of specified erosion strength are presented and illustrated by examples. Erosion strength characteristics are given for various aerospace materials. V.L.

A81-46850 # **Analytical and computer-aided design of automated systems for the testing of aircraft engines (Analiticheskoe i mashinnoe proektirovanie avtomatizirovannykh sistem ispytanii aviatsionnykh dvigatelei).** Iu. V. Kozhevnikov, V. S. Moiseev, Iu. V. Meluzov, and A. Kh. Khairullin. Moscow, Izdatel'stvo Mashinostroenie, 1980. 272 p. 58 refs. In Russian.

Problems of the analytical and computer-aided design of automated systems for the testing of aircraft engines are considered from unified scientific and methodological points of view. The problems are examined in the light of systems analysis, the mathematical modeling of test objects and processes, and the theories of optimization, statistical decision making, and queueing. Attention is given to methods for the optimal evaluation and correction of engine characteristics, and to criteria for the computer-aided optimization of structures and the evaluation of the efficiency of automated test systems. B.J.

A81-47125 # **Precision DME for microwave landing system.** F. Chiarini, M. Gori (Fabbrica Apparecchiature per Communicazioni Elettriche Standard S.p.A., Laboratorio Centrale Industrie, Pomezia, Italy), G. Corazza, and G. Falciasecca (Fondazione Ugo Bordoni, Centre Onde Millimetriche, Pontecchio Marconi, Italy). *Electrical Communication*, vol. 55, no. 4, 1980, p. 292-303. 8 refs.

It is noted that the distance measuring equipment (DME) that will be used with the new microwave landing system must provide much better accuracy than the existing system. To ensure interoperability with the existing system, however, it is desirable to upgrade the present equipment rather than to design a completely new one. An L-band fully compatible precision DME with the required accuracy is proposed on the basis of a new technique known as double pulse shaping. An example is presented of the application of the technique based on a tentative error budget. C.R.

STAR ENTRIES

N81-30080*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INFLUENCE OF FRICTION FORCES ON THE MOTION OF VTOL AIRCRAFT DURING LANDING OPERATIONS ON SHIPS AT SEA
James C. Howard and David O. Chin Sep. 1981 40 p refs
(NASA-TM-81305; A-8641) Avail: NTIS HC A03/MF A01 CSCL 01B

Equations describing the friction forces generated during landing operations on ships at sea were formulated. These forces depend on the platform reaction and the coefficient of friction. The platform reaction depends on the relative sink rate and the shock absorbing capability of the landing gear. The friction coefficient varies with the surface condition of the landing platform and the angle of yaw of the aircraft relative to the landing platform. Landings by VTOL aircraft, equipped with conventional oleopneumatic landing gears are discussed. Simplifications are introduced to reduce the complexity of the mathematical description of the tire and shock strut characteristics. Approximating the actual complicated force deflection characteristic of the tire by linear relationship is adequate. The internal friction forces in the shock strut are included in the landing gear model. A set of relatively simple equations was obtained by including only those tire and shock strut characteristics that contribute significantly to the generation of landing gear forces. A.R.H.

N81-30083*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPERIMENTAL AERODYNAMIC CHARACTERISTICS OF TWO V/STOL FIGHTER/ATTACK AIRCRAFT CONFIGURATIONS AT MACH NUMBERS FROM 1.6 TO 2.0
Walter P. Nelms, Donald A. Durston, and J. R. Lummus (General Dynamic Corp., Fort Worth, Tex.) May 1981 292 p refs Sponsored in part by the Navy
(NASA-TM-81286; A-8559) Avail: NTIS HC A12/MF A01 CSCL 01A

Tests were conducted in the Ames 9 by 7 ft supersonic wind tunnel to measure the aerodynamic characteristics of two horizontal attitude takeoff and landing V/STOL fighter/attack aircraft concepts. One concept featured a jet diffuser ejector for its vertical lift system and the other employed a remote augmentation lift system (RALS). Test results for Mach numbers from 1.6 to 2.0 are reported. Effects of varying the angle of attack (-4 deg to +17 deg), angle of sideslip (-4 deg to +8 deg) Mach number, and configuration building were investigated. The effects of wing trailing edge flap deflections, canard incidence, and vertical tail deflections were also explored as well as the effects of varying the canard longitudinal location and shapes of the inboard nacelle body strakes. A.R.H.

N81-30084*# Boeing Commercial Airplane Co., Seattle, Wash.
AN INVESTIGATION OF ENGINE INFLUENCE ON INLET PERFORMANCE
Brent K. Hodder 1981 88 p refs
(Contract NAS2-06017)
(NASA-CR-166136; D6-49228) Avail: NTIS HC A05/MF A01 CSCL 01A

The performance of a conventional engine/inlet installation, in which inlet and engine flow field interaction occurs, was compared to the performance of the same inlet remote coupled to the engine. The remote coupled inlet configuration decouples the influence of the engine on the inlet flow field and simulates current small scale inlet test techniques in which inlet airflow is provided by a vacuum source or coupled engine. The investigation was conducted in the NASA-Ames 40- by 80-foot wind tunnel using a General Electric TF-34 turbofan engine and a subsonic inlet havng an average inlet contraction ratio of 1.26. Test results indicated that engine interaction allows the inlet to operate with lower distortion levels at and beyond the separation angle-of-attack experienced without engine interaction. T.M.

N81-30085*# Douglas Aircraft Co., Inc., Long Beach, Calif.
ANALYSIS OF MACH NUMBER 0.8 TURBOPROP SLIPSTREAM WING/NACELLE INTERACTIONS Final Report
H. Robert Welge, Dan H. Neuhart, and John A. Dahlin 6 Aug. 1981 84 p refs
(Contract NAS2-10881)
(NASA-CR-166214; ACEE-25-FR-1564) Avail: NTIS HC A05/MF A01 CSCL 01A

Data from wind tunnel tests of a powered propeller and nacelle mounted on a supercritical wing are analyzed. Installation of the nacelle significantly affected the wing flow and the flow on the upper surface of the wing is separated near the leading edge under powered conditions. Comparisons of various theories with the data indicated that the Neumann surface panel solution and the Jameson transonic solution gave results adequate for design purposes. A modified wing design was developed (Mod 3) which reduces the wing upper surface pressure coefficients and section lift coefficients at powered conditions to levels below those of the original wing without nacelle or power. A contoured over the wing nacelle that can be installed on the original wing without any appreciable interference to the wing upper surface pressure is described. J.D.H.

N81-30086*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECT OF SIMULATED IN-FLIGHT THRUST REVERSING ON VERTICAL-TAIL LOADS OF F-18 AND F-15 AIRPLANE MODELS
E. Ann Bare, Bobby L. Berrier, and Francis J. Capone Aug. 1981 53 p refs
(NASA-TP-1890; L-14531) Avail: NTIS HC A04/MF A01 CSCL 01A

Investigations were conducted in the Langley 16-Foot Transonic Tunnel to provide data on a 0.10-scale model of the prototype F-18 airplane and a 0.047-scale model of the F-15 three-surface configuration (canard, wing, and horizontal tails). Test data were obtained at static conditions and at Mach numbers from 0.6 to 1.2 over an angle-of-attack range from 2 deg to 15 deg. Nozzle pressure ratio was varied from jet off to about 8.0. T.M.

N81-30087*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WING-ALONE AERODYNAMIC CHARACTERISTICS FOR HIGH ANGLES OF ATTACK OF SUPERSONIC SPEEDS
Robert L. Stallings, Jr. and Milton Lamb Jul. 1981 190 p refs
(NASA-TP-1889; L-14546) Avail: NTIS HC A09/MF A01 CSCL 01A

An experiment was conducted to determine wing-alone supersonic aerodynamic characteristics at high angles of attack. The wings tested varied in aspect ratio from 0.5 to 4.0 and in taper ratio from 0 to 1.0. The wings were tested at angles of attack ranging rom -5 deg to 60 deg and at Mach number from 1.60 to 4.60. The aerodynamic characteristics were obtained by integrating local pressures measured over the wing surfaces. Presented and discussed are results showing the effects of aspect ratio, taper ratio, Mach number, and angle of attack on force and moment coefficients and center of pressure locations. Also included are tabulations of the pressure measurements. T.M.

N81-30088*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPUTER ANALYSIS OF FLOW PERTURBATIONS GENERATED BY PLACEMENT OF CHOKE BUMPS IN A WIND TUNNEL
Richard L. Campbell Aug. 1981 44 p refs
(NASA-TP-1892; L-14415) Avail: NTIS HC A03/MF A01 CSCL 01A

An inviscid analytical study was conducted to determine the upstream flow perturbations caused by placing choke bumps in a wind tunnel. A computer program based on the stream-tube curvature method was used to calculate the resulting flow fields for a nominal free-stream Mach number range of 0.6 to 0.9. The choke bump geometry was also varied to investigate the effect of bump shape on the disturbance produced. Results from the study indicate that a region of significant variation from the free-stream conditions exists upstream of the throat of the tunnel. The extent of the disturbance region was, as a rule, dependent

on Mach number and the geometry of the choke bump. In general, the upstream disturbance distance decreased for increasing nominal free-stream Mach number and for decreasing length-to-height ratio of the bump. A polynomial-curve choke bump usually produced less of a disturbance than did a circular-arc bump and going to an axisymmetric configuration (modeling choke bumps on all the tunnel walls) generally resulted in a lower disturbance than with the corresponding two dimensional case. Author

N81-30091# Auburn Univ., Ala. Engineering Experiment Station.

AN AERODYNAMIC ANALYSIS OF DEFORMED WINGS IN SUBSONIC AND SUPERSONIC FLOW Final Report, Jan. 1980 - Apr. 1981

John E. Burkhalter, John M. Abernathy, and Milton E. Vaughn, Jr. Apr. 1981 201 p refs
(Contract DAAG29-78-G-0036)
(AD-A101675; ARO-15666.4-A-E) Avail: NTIS HC A10/MF A01 CSCL 20/4

The aerodynamic loading for deformed wings with elevons in both subsonic and supersonic flow is considered. The solution procedure falls into the potential flow category with appropriate restrictions. For subsonic flow, a lifting surface Kernel function formulation is used in which the local pressure loading for both wing and elevon is determined simultaneously in a semi-closed summation manner. Cases under study included gaps between wing and elevon in addition to arbitrary wing-elevon deformations. Results for all cases compared very well with experimental data. Experimental data taken in a low speed wind tunnel is also presented for a cropped delta wing and rectangular elevon in which the wing-elevon gap was the primary test variable. For supersonic flow, 3-D supersonic theory forms the basis for the solution procedure. Deformations are accounted for with the use of the doublet paneling added to the basic 3-D solution. Results agree very well with existing experimental data. The gapped elevon and thick wing trailing edge problem is also addressed with satisfactory results. Author (GRA)

N81-30098*# Control Data Corp., Hampton, Va.

LEARNING GUIDE FOR THE TERMINAL CONFIGURED VEHICLE ADVANCED GUIDANCE AND CONTROL SYSTEM MODE SELECT PANEL

Mark A. Anderson and Ron Callahan Jul. 1981 20 p refs
(Contract NAS1-15673)
(NASA-CR-165751) Avail: NTIS HC A02/MF A01 CSCL 01C

This learning guide is designed to assist pilots in taking the PLATO presimulator training course on the advanced guidance and control system mode select panel. The learning guide is divided into five sections. The first section, the introduction, presents the course goals, prerequisites, definition of PLATO activities, and a suggested approach to completing the course. The remaining four sections present the purpose, learning activities and summary of each lesson of the AGCS PLATO course, which consists of (1) AGCS introduction; (2) lower order modes; (3) higher order modes; and (4) an arrival route exercise. Author

N81-30101*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

GUIDELINES FOR LINE-ORIENTED FLIGHT TRAINING, VOLUME 1

John K. Lauber and H. Clayton Foushee Aug. 1981 46 p refs Proceedings of NASA/Industry Workshop, Moffett Field, Calif., 13-15 Jan. 1981
(NASA-CP-2184; A-8585-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 01C

Line-Oriented Flight Training (LOFT) is a developing training technology which synthesizes high-fidelity aircraft simulation and high-fidelity line-operations simulation to provide realistic, dynamic pilot training in a simulated line environment. LOFT is an augmentation of existing pilot training which concentrates upon command, leadership, and resource management skills. This report, based on an NASA/Industry workshop held in January, 1981, is designed to serve as a handbook for LOFT users. In addition to providing background information, guidelines are presented for designing LOFT scenarios, conducting real-time LOFT operations, pilot debriefing, and instructor qualification and training. The final chapter addressed other uses of LOFT and line-operations (or full-mission) simulation. Author

N81-30102# BDM Corp., McLean, Va.

DEFINITION OF INVESTIGATIVE AREAS FOR HUMAN-FACTOR ASPECTS OF AIRCRAFT ACCIDENTS Final Report, 13 Mar. - 23 Dec. 1979

Michael Fineberg, John Woelfel, Robin Ely, and Marcia Smith Dec. 1980 130 p refs
(Contract F33615-79-C-0608; AF Proj. 2787)
(AD-A101601; BDM/W-79-733-TR; SAM-TR-80-48) Avail: NTIS HC A07/MF A01 CSCL 01/3

This paper is the final report of a 9-month survey effort designed to identify the major pilot factors involved in aircraft mishaps, rank order the major pilot factors in relation to a return-on-investment metric, identify aviation technologies with a high potential for diagnosing and/or reducing these pilot factors, and suggest potentially high-payoff programs for researching the pilot factor aspects of aircraft for the purpose of reducing their incidence. Author (GRA)

N81-30103# Federal Aviation Administration, Atlantic City, N.J.

AIRCRAFT RESEARCH AND TECHNOLOGY FOR ANTIMISTING KEROSENE CONFERENCE

Jun. 1981 260 p Proceedings held at Atlantic City, N.J. 18-19 Feb., 1981
(AD-A101347; FAA-CT-81-181) Avail: NTIS HC A12/MF A01 CSCL 01/2

Contents: Antimisting Fuel Engineering and Development Program, Wing Spillage Test, Flammability Comparison Test Apparatus, Large-Scale Aircraft Crash Test of Antimisting Fuel, The Use of Antimisting Kerosene in Turbofan Jet Engines, The Development of ICI'S FM-9 Antimisting Aviation Fuel, Cryogenic Blending Polymer Additives in Fuel, Economic Aspects of Conversion to Antimisting Fuels, UK Programme on Safety Fuels, Fundamental Studies of Antimisting Fuels, Degradation and Characterization of Antimisting Kerosene, Antimisting Fuel Test Correlation Analysis, and KS/DC-10 Fuel System Simulator. GRA

N81-30104# Federal Aviation Administration, Atlantic City, N.J. Technical Center.

A COMPENDIUM OF AIRCRAFT COCKPIT VISION SURVEYS, 1950 THROUGH 1980, VOLUME 1 Final Report, 1950-1980

Anthony J. Barile May 1981 148 p refs
(AD-A101473; FAA-CT-81-40-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 01/3

This publication contains a history of cockpit of visibility surveys which were conducted to measure and record aircraft (General Aviation, Transport, Helicopter, Military) cockpit visibility. Many of the aircraft were involved in midair collisions, accident investigations, research and development, and the design up through production implementation. The Federal Aviation Administration (FAA) Binocular Camera is a standard means to accurately measure cockpit visibility, which in the certification process for civil aircraft is an invaluable tool for industry and the FAA. Therefore, the information contained in this document is intended to contribute to aviation safety. Author (GRA)

N81-30105# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Drehfluegler.

APPLICATION OF DAMAGE TOLERANCE CONCEPTS FOR MBB HELICOPTERS

M. vonTapavicza and F. Och 12 Sep. 1980 11 p refs Presented at 51st AGARD Struct. and Mater. Panel on Helicopter Fatigue Life Assessment, Aix-en-Provence, France, 14-19 Sep. 1980
(MBB-UD-309/80-OE) Avail: NTIS HC A02/MF A01

Components were tested in order to determine the location and modes of damage, and to establish how many redundant elements can fail without adversely affecting the capacity of the equipment to withstand limiting loads. Maximum safety and performance are sought for minimum weight and costs. The time elapsing between the onsat of damage and the moment when failure occurs is determined from inspection tests. Probable lives are calculated from experimental S-N curves, the corresponding strength reduction factor being an important parameter Damage tolerance is based on combined safe life and slow crack growth evaluations. The methodology adopted for two types of helicopter is presented. It is shown that safety criteria can be respected by applying stringent conditions to just a few vital components. These components are defined and some test results are given. Author (ESA)

N81-30106*# Battelle Columbus Labs., Mountain View, Calif.
OPERATIONAL PROBLEMS EXPERIENCED BY SINGLE PILOTS IN INSTRUMENT METEOROLOGICAL CONDITIONS Interim Report
Stacy Weislogel 5 Aug. 1981 74 p refs
(Contract NAS2-10060)
(NASA-CR-166236) Avail: NTIS HC A04/MF A01 CSCL 17G

The development and implementation of a search strategy to extract pertinent reports from the Aviation Safety Reporting System-2 (ASRS-2) database are described. For any particular occurence to be pertinent to the study, it must have satisfied the following conditions: the aircraft must be of the type usually flown by a single pilot; operation on an IFR flight plan in instrument meteorological conditions; pilot experienced an operational problem. The occurances consist of reports by the pilot about his own performance, by the pilot about the system performance, or by an air traffic controller about a pilot's performance. T.M.

N81-30107# Mitre Corp., McLean, Va.
DISCRETE ADDRESS BEACON SYSTEM DATA LINK CAPACITY REQUIREMENTS Final Report
Anand D. Mundra Dec. 1980 124 p refs
(Contract DOT-FA80WAI-4370)
(AD-A101731; MTR-80W302; FAA-RD-81-56) Avail: NTIS HC A06/MF A01 CSCL 17/7

The Federal Aviation Administration plans to deploy the Discrete Address Beacon System (DABS) as a key feature of its upgraded third generation Air Traffic Control System. DABS provides an integral data link capable of conducting rapid transfer of data between the sensor and DABS equipped aircraft. This study establishes the performance requirements of the DABS data link to be able to provide the various services that may reasonably be expected to be delivered by DABS during its life time. GRA

N81-30110*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE USE OF INTERPRACTIVE GRAPHIC DISPLAYS FOR INTERPRETATION OF SURFACE DESIGN PARAMETERS
Noel A. Talcott, Jr. May 1981 27 p refs
(NASA-TM-81963; L-14112) Avail: NTIS HC A03/MF A01 CSCL 01C

An interactive computer graphics technique known as the Graphic Display Data method has been developed to provide a convenient means for rapidly interpreting large amounts of surface design data. The display technique should prove valuable in such disciplines as aerodynamic analysis, structural analysis, and experimental data analysis. To demonstrate the system's features, an example is presented of the Graphic Data Display method used as an interpretive tool for radiation equilibrium temperature distributions over the surface of an aerodynamic vehicle. Color graphic displays were also examined as a logical extension of the technique to improve its clarity and to allow the presentation of greater detail in a single display. Author

N81-30111*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
COMPARISON OF THREE THRUST CALCULATION METHODS USING IN-FLIGHT THRUST DATA
Donald L. Hughes Jul. 1981 35 p refs
(NASA-TM-81360; H-1141) Avail: NTIS HC A03/MF A01 CSCL 01C

The gross thrust of an experimental airplane was determined by each method using the same flight maneuvers and generally the same data parameters. Coefficients determined from thrust stand calibrations for each of the three methods were then extrapolated to cruise flight conditions. The values of total aircraft gross thrust calculated by the three methods for cruise flight conditions agreed within + or - 3 percent. The disagreement in the values of thrust calculated by the different techniques manifested itself as a bias in the data. There was little scatter (0.5 percent) for the thrust levels examined in flight. T.M.

N81-30112*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
BEHAVIOR OF AIRCRAFT ANTISKID BRAKING SYSTEMS ON DRY AND WET RUNWAY SURFACES: HYDROMECHANICALLY CONTROLLED SYSTEM
John A. Tanner, Sandy M. Stubbs, and Eunice G. Smith Aug. 1981 176 p refs
(NASA-TP-1877; L-14549) Avail: NTIS HC A09/MF A01 CSCL 01C

The investigation utilized one main gear wheel, brake, and tire assembly of a McDonnell Douglas DC-9 series 10 airplane. The landing-gear strut was replaced by a dynamometer. During maximum braking, average braking behavior indexes based upon brake pressure, brake torque, and drag-force friction coefficient developed by the antiskid system were generally higher on dry surfaces than on wet surfaces. The three braking behavior indexes gave similar results but should not be used interchangeably as a measure of the braking of this antiskid sytem. During the transition from a dry to a flooded surface under heavy braking, the wheel entered into a deep skid but the antiskid system reacted quickly by reducing brake pressure and performed normally during the remainder of the run on the flooded surface. The brake-pressure recovery following transition from a flooded to a dry surface was shown to be a function of the antiskid modulating orifice. T.M.

N81-30113# Systems Technology, Inc., Hawthorne, Calif.
INVESTIGATION OF HIGH-ANGLE-OF-ATTACK MANEUVER-LIMITING FACTORS. PART 1: ANALYSIS AND SIMULATION Final Report, 13 May 1976 - 30 Jul. 1980
Donald E. Johnston, David G. Mitchell, and Thomas T. Myers Dec. 1980 203 p refs
(Contract F33615-76-C-3072; AF Proj. 2403)
(AD-A101646; STI-TR-1081-1-Pt-1; AFWAL-TR-80-3141-Pt-1)
Avail: NTIS HC A10/MF A01 CSCL 01/3

The high angle of attack, low speed stall/departure characteristics of the F-4J and F-14A are analyzed, using a six degree of freedom mathematical model with nonlinear aerodynamics. Cause-effect relationships are investigated for maneuver limiting factors including wing rock, nose slice, and rolling departures. Cross derivatives of L alpha, N alpha, and M beta alter key transfer function parameters. A piloted simulation validates analytic predictions and demonstrate that departure warning, susceptibility, and severity are strongly influenced by the static cross derivatives. A connection between roll numerator parameter values and pilot perception of departure susceptibility and severity is identified. Potential modifications for the high AOA sections of the MIL-F-8785B Flyin Qualities Specifications are proposed: a criterion for the real part of the roll numerator root, further recommendations for minimizing departure susceptibility and certain sideslip influences, and a flying quality rating form for assessing departure and recovery characteristics. GRA

N81-30114# Systems Technology, Inc., Hawthorne, Calif.
INVESTIGATION OF HIGH-ANGLE-OF-ATTACK MANEUVER-LIMITING FACTORS. PART 2: PILOTED SIMULATION ASSESSMENT OF BIHRLE DEPARTURE CRITERIA Final Report, 13 May 1976 - 30 Jul. 1980
David G. Mitchell and Donald E. Johnston Dec. 1980 51 p refs
(Contract F33615-76-C-3072; AF Proj. 2403)
(AD-A101647; STI-TR-1081-1-Pt-2; AFWAL-TR-80-3141-Pt-2)
Avail: NTIS HC A04/MF A01 CSCL 01/3

Analytical prediction and piloted simulation results for a specific set of programmed control deflections are compared for the F-4J and F-14A aircraft. GRA

N81-30115# Systems Technology, Inc., Hawthorne, Calif.
INVESTIGATION OF HIGH-ANGLE-OF-ATTACK MANEUVER-LIMITING FACTORS. PART 3: APPENDICES, AERODYNAMIC MODELS Final Report, 13 May 1976 - 30 Jul. 1980
David G. Mitchell, Thomas T. Myers, Gary L. Teper, and Donald E. Johnston Dec. 1980 124 p refs
(Contract F33615-76-C-3072; AF Proj. 2403)
(AD-A101648; STI-TR-1081-1-Pt-3; AFWAL-TR-80-3141-Pt-3)
Avail: NTIS HC A06/MF A01 CSCL 01/3

Aerodynamic models employed in the F-4J and F-14A high angle of attack analysis and validation are presented as well as the equations of motion, aerodynamic models, and control system configurations, used in the piloted simulation. GRA

N81-30116# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
EXPERIMENTAL DEVELOPMENT OF AN ADVANCED CIRCULATION CONTROL WING SYSTEM FOR NAVY STOL AIRCRAFT Research and Development Report
J. H. Nichols, Jr., R. J. Englar, M. J. Harris, and G. G. Huson

May 1981 19 p refs Presented at the AIAA Aerospace Sci. Meeting (19th), St. Louis, 12-15 Jan. 1981
(WF41421000)
(AD-A101309; DTNSRDC/AERO-1272; DTNSRDC-81/045; AIAA-Paper-81-0151) Avail: NTIS HC A02/MF A01 CSCL 20/4

An advanced high lift system is being developed which combines a Circulation Control Wing (CCW) with Upper Surface Blowing (USB) to produce significant lift for STOL operations by Navy aircraft. The concept uses circulation control to pneumatically deflect USB engine thrust and thus augment aerodynamic wind lift produced by the outboard CCW. Two series of wind tunnel investigations have confirmed significant thrust turning to angles near 160 deg, suggesting the possibility for a simple, highly effective STOL and thrust reverser system. Two dimensional investigations of reduced diameter CCW trailing edges suggest their application as a no-moving-parts high lift system with minimal cruise penalty. The paper presents these experimental results and summarizes the technology development progressing towards an advanced STOL aircraft. Author (GRA)

N81-30117# Kaman Aerospace Corp., Bloomfield, Conn.
MM&T: LOW COST PRODUCTION/INSTALLATION OF URETHANE LEADING EDGE GUARDS ON ROTOR BLADES Final Report, 23 Aug. 1979 - 9 Dec. 1980
M. L. White and A. I. Belbruno Jun. 1981 57 p
(Contract DAAK51-79-C-0024)
(AD-A101603; R-1627A; USAAVRADCOM-TR-81-D-10) Avail: NTIS HC A04/MF A01 CSCL 01/3

A process for a low cost production/installation of urethane leading edge guards for rotor blades was developed. A survey of manufacturers and literature was conducted for suitable erosion guard materials. Flow, bonding, and temperature characteristics of the selected material were determined. The feasibility of the process of molding a boot on a 4 foot section of blade was demonstrated. From the results obtained in the molding phase, the tool concept and design was refined and a tool was fabricated to mold an erosion boot on a full length blade. Four full scale leading edge erosion boots were formed, bonded, and inspected. The costs were compared to current production process. GRA

N81-30119# Army Aviation Engineering Flight Activity, Edwards AFB, Calif. Directorate for Development and Qualification.
AH-1 LIGHTWEIGHT AIRBORNE LAUNCHER JETTISON EVALUATION Final Report, Sep. - Nov. 1980
Larry B. Higgins and John D. Ottomeyer Apr. 1981 22 p refs
(AD-A101461; USAAEFA-79-03) Avail: NTIS HC A02/MF A01 CSCL 19/7

An AH-1S jettison evaluation was made of the M261 19-round M260 7-round pre-production Lightweight Airborne Launcher (LWL). Forty-one flights totaling 11.5 flight hours were flown. The jettison characteristics of separation distance, time to clear or LWL motions did not appear to be significantly influenced by airspeed, sideslip angle or rate of descent. Satisfactory jettison envelopes for the pre-production M260 and M261 LWL were defined statically, at a hover, and in pilot perceived coordinated level flight to an airspeed of V(H) and partial power and autorotational descent to an airspeed of V(maxglide). The M260 and M261 LWL met the separation criteria of AMCP 706-203. GRA

N81-30120# General Electric Co., Burlington, Vt. Armament and Electrical Systems Dept.
HIGH IMPULSE GUN AIRBORNE DEMONSTRATION, GAU-13/A WEAPON, FEED SYSTEM, GUN DRIVE AND ELECTRONIC CONTROLS Final Technical Report, 3 Aug. 1979 - 31 Oct. 1980
Edwin J. DePasqual May 1981 34 p refs
(Contract DAAK10-79-C-0267)
(AD-A101698; Rept-81APB521) Avail: NTIS HC A03/MF A01 CSCL 19/6

The HIGAD test bed described in this report consists of a four barrel, GAU-8/A class, 30-mm Gatling type weapon with associated feeder and dual rate drive, and a microprocessor-controlled, hydraulically-operated recoil attenuation system. This recoil system is referred to as FORC (Force Optimized Recoil Control) and is used for the 360 shot-per-minute (spm) rate. A second recoil system is used for the higher rate of 720 spm. This system is a passive low force recoil system. Complete interface requirements were established through many joint meetings between General Electric, Honeywell, and ARRADCOM. The resulting test program has demonstrated flawless gun system performance in the HIGAD test bed. A total of 161 rounds were fired for set-up and checkout purposes at the General Electric Firing Range prior to delivery to ARRADCOM. At Rock Island, 972 rounds were accumulated on the gun system during evaluation of the FORC recoil system. GRA

N81-30121# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Drehfluegler.
BK 117: A NEW HELICOPTER THROUGH INTERNATIONAL COOPERATION
E. Weiland and I. Kagitomi (Kawasaki Heavy Industries, Gifu, Japan) 4 Sep. 1979 28 p Presented at 5th European Rotorcraft and Powered Lift Aircraft Forum, Amsterdam, 4-7 Sep. 1979
(MBB-UD-274/79-OE) Avail: NTIS HC A03/MF A01

The design of the BK-117 helicopter and the selection of the main parameters are discussed. Results of ground and flight testing are included. The BK-117 is an engine multipurpose helicopter equiped with AVCO-Lycoming LTS101 turboshaft engines with a 11 m four-bladed rotor of the rigid type. The maximum takeoff weight is 2800 kg and cruise speed is 265 km/h. A high degree of commonality with the BO-105 (from which it was developed) was sought. Author (ESA)

N81-30122# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Airplane Div.
STRUCTURAL OPTIMIZATION OF ADVANCED AIRCRAFT STRUCTURES
G. Schneider, H. Goedel, and O. Sensburg 11 Aug. 1980 15 p refs Presented at 12th ICAS Congress, Munich, 12-17 Oct. 1980
(MBB-S/PUB/32) Avail: NTIS HC A02/MF A01

The application of software systems for the automatic design of minimum weight structures (several elements) is described. The structural layout of a carbon fiber composite forward swept wing is depicted. It is shown that a structural optimization system can be very useful in the preliminary design of an aircraft, especially one divided into several modules (static load calculations; deformations and stress calculations by finite elements; static aeroelastics; weight calculations; unsteady aerodynamic forces; vibration calculations and flutter calculations) which can be used separately and independently. Cross checks can be performed, and postulated design goals can be achieved. The low divergence speed of forward swept wings can be increased sufficiently with zero or a small weight penalty. The system is suitable for future high performance aircraft. Author (ESA)

N81-30123# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Drehfluegler.
DEVELOPEMENT OF ANTIRESONANCE FORCE ISOLATORS FOR HELICOPTER VIBRATION REDUCTION
D. Braun 18 Aug. 1980 20 p refs Presented at 6th European Rotocraft and Powered Lift Aircraft Forum, Bristol, England, 16-19 Sep. 1980 Sponsored by Bundesministerium fuer Forschung und Technologie
(MBB-UD-305/80-OE) Avail: NTIS HC A02/MF A01

A conventional isolator with elastomeric pivots was developed and tested. This type of pivot was found to be the most suitable pendulum bearing. Another type of isolator of a simple wear resistant design provided with a passive hydraulic force generator was developed. It is completely symmetrical in structure and exhibits a very low degree of inherent damping. Accurate theoretical descriptions were established for both types of isolator, which are arranged at several points in different operating directions between the gearbox and fuselage. A uniaxial functional model was used to simulate the vertical motion of the helicopter. Good agreement is achieved between the theoretical and practical models. Quasi-static and dynamic life tests on the hydraulic version lead to the prediction of a service life of at least 2000 hours. Author (ESA)

N81-30124# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. VFW Technological Centre.
OPERATIONAL EXPERIENCE WITH ADHESIVE BONDED STRUCTURES

Rob J. Schliekelmann 1979 31 p refs
(FOK-BO-1235) Avail: NTIS HC A03/MF A01

Problem areas that require service, the principle causes of possible failures, and ways of achieving fully reliable bonded joints are discussed. Tables and diagrams detailing information received from airlines are given. With some exceptions, operational experience with honeycomb sandwich components is poor, but with metal-to-metal joints there is wide variation. The nature of the durability problems is such that causes of failure are identifiable and there is a good basis for improvement in bonded structures. Author (ESA)

N81-30125# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Helicopter and Transport Div.
HELICOPTER TECHNOLOGIES OF THE FUTURE
Kurt Pfleiderer 13 Oct. 1980 33 p Presented at Soc. of Automotive Engr., 1980
(MBB-UD-314/80-OE) Avail: NTIS HC A03/MF A01

An assessment of the future possibilities for the helicopter is presented, within the broad spectrum of all transport systems. Special attention is paid to weight reduction by extensive use of composites such as Kevlar fiber reinforced plastics. Crash resistance, ergonomic configuration optimization, aerodynamic improvements, vibration reduction, specific fuel consumption and noise reduction are discussed. Examples from the BO 105 and BK 117 helicopters are given. By the end of the century the helicopter is expected to reach the discussed development limits. Author (ESA)

N81-30127# AiResearch Mfg. Co., Torrance, Calif.
CRASH SURVIVABLE FLIGHT DATA RECORDING SYSTEM STUDY Final Report
30 Jun. 1981 355 p
(Contract F33615-80-C-0135)
(AD-A101503; Rept-81-17693; ASD-TR-5011) Avail: NTIS HC A16/MF A01 CSCL 14/3

This study reviews the requirements and available technology for crash survivable flight data recording systems. Primary efforts relate to fighter/attack aircraft, with the A-10, F-15 and F-16 used as specific examples. Results include design and performance characteristics of recommended systems and an analysis showing a high cost-effectiveness for implementation of such a CSFDRS. GRA

N81-30128# Arinc Research Corp., Annapolis, Md.
DEVELOPMENT OF AVIONICS INSTALLATION INTERFACE STANDARDS
Stewart Bailey, Neil Sullivan, and Atso Savisaar Jun. 1981 220 p
(Contract F04606-79-G-0082; AF Proj. 2257)
(AD-A101423; Rept-2258-03-2-2477) Avail: NTIS HC A10/MF A01

This document reports on the development of avionics installation standards for the avionics bay and cockpit areas of military aircraft. The standards were being developed through a co-operative industry/government open forum series of meetings. This report covers the preparation for the first meeting and the results of industry/government participation in the open forum. The draft avionics bay standard and a strawman control and display unit standard are attachments to the report. Author (GRA)

N81-30130*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROTOR WAKE CHARACTERISTICS RELEVANT TO ROTOR-STATOR INTERACTION NOISE GENERATION
Loretta M. Shaw and Joseph R. Balombin 1981 25 p refs Presented at 7th Acoustic Conf., Palo Alto, Calif., 5-7 Oct. 1981; Sponsored by AIAA
(NASA-TM-82703; E-984) Avail: NTIS HC A02/MF A01 CSCL 21E

Mean and turbulent wake properties at three axial locations behind the rotor of an aerodynamically loaded 1.2 pressure ratio fan were measured using a stationary cross film anemometer in an anechoic wind tunnel. Wake characteristics at four radial immersions across the duct at four different fan speeds were determined utilizing a signal enhancement technique. The shapes of the waveforms of the mean rotor relative and mean upwash velocities were shown to change significantly across the span of the blades. In addition, an increase in fan rotational speed caused an increase in the maximum wake turbulence intensity levels near the hub and tip. Spectral analysis was used to described the complex nature of the rotor wake. Author

N81-30131# Garrett Turbine Engine Co., Phoenix, Ariz.
SMALL TURBINE ENGINE AUGMENTOR. PHASE 1: PRELIMINARY DESIGN STUDIES OF AFTERBURNER AND DUCT-BURNER CONFIGURATIONS Interim Technical Report, 1 Aug. - 29 Oct. 1980
T. E. Kuhn, T. W. Bruce, and H. C. Mongia Mar. 1981 47 p refs
(Contract F33615-80-C-2001; AF Proj. 3066)
(AD-A101595; Rept-21-3805(01); AFWAL-TR-81-2008) Avail: NTIS HC A03/MF A01 CSCL 21/5

Several candidate afterburner and duct-burner concepts were evaluated. The evaluation procedure included assessing engine and augmentor performance when integrated with airframes and mission data available from ATCM potential contractors. From the candidates analyzed, two configurations were chosen for further design evaluation. Of the several augmentor concepts screened, the conventional flameholder with mixer-nozzle and the partial-swirl augmentor were determined to produce the highest combustion efficiency with the least impact on the size or performance of the core engine. These two designs were therefore selected for detail analysis. Two engines were evaluated for use in augmented cruise missiles. The lower-bypass-ratio engine was selected because of its smaller diameter, similarity to the Boeing ALCM-L engine, and greater suitability for augmentation. The effect of using JP-10 and RJ-6 fuels was predicted to be small, but carbon-slurry fuel will require extensive modifications to the fuel manifold. Author (GRA)

N81-30132# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
HIGH TEMPERATURE STRAIN GAGE SYSTEM FOR APPLICATION TO TURBINE ENGINE COMPONENTS Final Report, 15 Jun. 1976 - 15 Aug. 1980
R. A. Weise and J. H. Foster Jan. 1981 253 p refs
(Contract F33615-76-C-2075; AF Proj. 3066)
(AD-A101713; R80AEG388; AFWAL-TR-80-2126) Avail: NTIS HC A12/MF A01 CSCL 14/2

A three-phase program was completed to develop reliable, high temperature dynamic strain gage systems for application to turbine engine components operating to 1500 F. The strain gage element, intermediate leads and gage fabrication processes that evolved are used over the full temperature range: however, two different application techniques are required to achieve maximum fatigue strength to 1500 F. A composite-ceramic application design is recommended to 700 F. At higher temperatures, the all-FSA or Rokide design is preferred. Gage factor stabilization procedures were established. A strain gage reliability demonstration was conducted on an engine compressor and showed the composite-ceramic gage to have better reliability below 700 F. The report includes a detailed procedure of gage fabrication and application. Author (GRA)

N81-30133# Rolls-Royce Ltd., Derby (England).
PROGRAMMES FOR MILITARY ENGINES WITH COST OBJECTIVES
Claude Foure 1980 47 p Transl. into ENGLISH from French Conf. paper presented at AGARD Conf.
(PNR-90058; AGARD-LS-107; Trans-15261) Avail: NTIS HC A03/MF A01

Management techniques for military aircraft engine design, production and maintenance referred to cost objectives are discussed. Life cycle cost, engine reliability, direct operating cost, purchasing cost, and the relationship between technical and cost objectives are examined. The techniques for cost forecasting are reviewed. The type of organization suited to follow both technical and cost objectives is analyzed. A maintenance method called Individually Repaired Subassemblies is detailed. The maintenance studies done for the Larzac aircraft fleet are presented. The spectrometric analysis of oil, particle analysis, vibration analysis, gammagraphy and endoscopy as maintenance techniques are also discussed. Author (ESA)

N81-30134*# Kansas Univ. Center for Research, Inc., Lawrence Flight Research Lab.
A PROGRAM TO EVALUATE A CONTROL SYSTEM BASED ON FEEDBACK OF AERODYNAMIC PRESSURE DIFFERENTIALS, PART 1 Interim Report
Ronald R. Hrabak, David W. Levy, Paul Finn, and Jan Roskam

Aug. 1981 213 p refs
(Grant NAG4-5)
(NASA-CR-164684; KU-FRL-490-1-Pt-1) Avail: NTIS HC A10/MF A01 CSCL 01C

The use of pressure differentials in a flight control system was evaluated. The pressure profile around the test surface was determined using two techniques: (1) windtunnel data (actual); and (2) NASA/Langley Single Element Airfoil Computer Program (theoretical). The system designed to evaluate the concept of using pressure differentials is composed of a sensor drive and power amplifiers, actuator, position potentiometer, and a control surface. The characteristics (both desired and actual) of the system and each individual component were analyzed. The desired characteristics of the system as a whole are given. The flight control system developed, the testing procedures and data reduction methods used, and theoretical frequency response analysis are described. J.M.S.

N81-30135*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.

A PROGRAM TO EVALUATE A CONTROL SYSTEM BASED ON FEEDBACK OF AERODYNAMIC PRESSURE DIFFERENTIALS. PART 2: DATA REPORT FOR PHASE 1 WIND TUNNEL TEST Interim Report

Ronald R. Hrabak, David W. Levy, Paul Finn, and Jan Roskam Aug. 1981 119 p refs
(Grant NAG4-5)
(NASA-CR-164685; KU-FRL-490-1-Pt-2) Avail: NTIS HC A06/MF A01 CSCL 01C

Wind tunnel test data are presented. The purpose of the test was to determine the sensor location for sensitivity to flap deflection and to determine the range required of the sensor. The calculations followed to correct the raw pressure measurements, the corrected measurements, which represent the static pressures along the airfoil surface, and the static pressures tabulated and in coefficient form are described. However, the chordwise locations of the upper and lower surface taps do not coincide. An interpolation routine is performed to find the lower surface pressure coefficients at the upper surface tap locations. The difference, C sub P(lower) - C sub P(upper), is calculated and listed and the data are reorganized with respect to each tap location. A numerical regression performed to quantify the slopes of the graphs allows more accurate comparison of sensitivity and linearity. J.M.S.

N81-30136*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SIMULATION STUDY OF TWO VTOL CONTROL/DISPLAY SYSTEMS IN IMC APPROACH AND LANDING

Vernon K. Merrick Aug. 1981 90 p refs
(NASA-TM-81295; A-8592) Avail: NTIS HC A05/MF A01 CSCL 01C

Both systems had full attitude command; the more complex system (Type 1) also had translational velocity command. The systems were applied to existing models of a VTOL lift-fan transport and the AV-8A Harrier. Simulated landings were made on a model of a DD963 Spruance-class destroyer. It was concluded that acceptable transitions and vertical landings can be performed, using the Type 1 system, in free-air turbulence up to 2.5 m/sec and sea state 6 and, using the Type 2 system, in free-air turbulence up to 1.5 m/sec and sea state 4. T.M.

N81-30137*# Vigyan Research Associates, Inc., Hampton, Va.

SUBSONIC PITCH-UP ALLEVIATION ON A 74 DEG DELTA WING

Dhanvada M. Rao and Thomas D. Johnson, Jr. (Kentron International, Inc., Hampton, Va.) Jul. 1981 20 p refs
(Contract NAS1-16259)
(NASA-CR-165749) Avail: NTIS HC A02/MF A01 CSCL 01C

Fixed leading-edge devices were investigated for alleviating the low speed pitch-up and longitudinal instability of a 74 deg delta wing model. In wind-tunnel tests, Pylon Vortex Generators were shown to be highly effective, compared to leading-edge fences and slots, in raising the pitch-up angle of attack from 8 deg to 28 deg. The subsonic drag penalty was negligible. Author

N81-30138*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Control Dynamics Branch.

A CONTINUOUSLY RECONFIGURING MULTIMICROPROCESSOR FLIGHT CONTROL SYSTEM Final Report, 1 Aug. 1979 - 30 Apr. 1981

Stanley J. Larimer and Scott L. Maher May 1981 150 p refs
(AF Proj. 2403)
(AD-A101412; AFWAL-TR-81-3070) Avail: NTIS HC A07/MF A01 CSCL 09/2

Recent research at the US Air Force Wright Aeronautical Laboratories (Flight Dynamics Lab) has resulted in the development of a promising microprocessor-based flight control system design. This system is characterized by a collection of cooperatively autonomous distributed microcomputers interconnected by an arbitrary number of common serial multiplex busses. Each processor in the system independently determines its assignments using a simple algorithm that dynamically redistributes system functions from processor to processor in a never-ending process of reconfiguration. This approach offers several benefits in terms of system reliability, and the architecture in general incorporates many state-of-the-art features which promise improved system throughput, expandability, and above all, ease of programming. GRA

N81-30139# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Drehflueger.

FLIGHT INVESTIGATIONS OF A HELICOPTER LOW AIRSPEED ESTIMATION SYSTEM BASED ON MEASUREMENT OF CONTROL PARAMETERS

A. J. Faulkner and F. Buchner 11 Aug. 1980 23 p refs Presented at 6th European Rotocraft and Powered Lift Aircraft Forum, Bristol, England, 16-19 Sep. 1980
(MBB-UD-306/80-OE) Avail: NTIS HC A02/MF A01

An indirect method for estimating airspeed, particularly suitable for modern hingless-rotor helicopters, is described. Air-speed indication is useful since handling characteristics are primarily dependent on the rotor in-plane component. The theoretical analysis developed uses of an existing simplified analytical solution (not involving nonlinear effects) for rotor flapping and thrust equations. These equations are inverted and appropriate approximations made for second-order quantities. Equations are thus derived for the longitudinal and lateral aerodynamic velocity components. Experimental results obtained for trimmed and transient flight states are presented. A 16 bit processor was employed. Particular attention is given to the rotor down-wash model together with instrumentation and accuracy improvements obtainable. Author (ESA)

N81-30140# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Drehfluegler.

PARAMETER IDENTIFICATION OF A HINGELESS ROTOR HELICOPTER IN FLIGHT CONDITIONS WITH INCREASED INSTABILITY

M. Kloster, J. Kaletka (DFVLR, Brunswick), and H. Schaeufele 1 Sep. 1980 24 p refs Presented at 6th European Rotocraft and Powered Lift Aircraft Forum, Bristol, England, 16-19 Sep. 1980
(MBB-UD-307/80-OE) Avail: NTIS HC A02/MF A01

Hover and flight at maximum speed were studied. Both flight conditions were performed with maximum weight and a mid center of gravity position. An attitude feedback control system was necessary because of the instability. A strapdown system was used for measurements. Closed loop stabilization was obtained with an onboard computer. The input signals of the unstabilized helicopter were optimized. Time and frequency calculations show that special input signals are needed for the closed loop system. A special distribution of the power spectrum leads to a quasi-optimized input signal. These signals were filtered with second order linear filters to suppress rotor dynamics, derivatives identified from flight tests (six degree of freedom rigid body model) are compared with the results of nonlinear simulation and quasistatic theory. In general, agreement is good. Author (ESA)

N81-30141# Naval Civil Engineering Lab., Port Hueneme, Calif.

RECYCLING OF PORTLAND CEMENT CONCRETE AIRPORT

PAVEMENTS: A STATE-OF-THE-ART STUDY Final Report, Oct. 1979 - Sep. 1980
M. C. Hironaka, R. B. Brownie, and G. Y. Wu Apr. 1981 36 p refs
(Contract DOT-FA77WAI-704)
(AD-A101482; FAA-RD-81-5) Avail: NTIS HC A03/MF A01 CSCL 11/2

An investigation was performed to assess the state-of-the-art of recycling Portland cement concrete (PCC) airport pavements. Previous laboratory studies have shown that recycling of PCC pavements is technically and economically feasible. This has been demonstrated in airport reconstruction projects at Jacksonville International Airport (Florida), Love Field (Texas), and Coffeyville Municipal Airport (Kansas), where PCC was recycled into econocrete base and aggregate subbase, cement stabilized base, and part of the aggregate base course, respectively. Recycling of PCC for surface courses in airport pavement construction has not yet been performed, but this should also prove to be beneficial as has been experienced by the Iowa DOT and other state highway agencies who have recycled PCC for surface courses. Equipment for recycling PCC pavements is currently available in the construction industry; however, these, along with the technology of PCC recycling, could be improved substantially. Recommendations for specific improvements are therefore made. Author (GRA)

N81-30143# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Apparate.
DIGITAL DATA BASES FOR VISUAL AND RADAR SIMULATION
Barbara Diess 5 Sep. 1980 12 p refs
(MBB-UA-549/80-OE) Avail: NTIS HC A02/MF A01

Criteria for a relevant mathematical description of the a simplified real world are defined and a computerized interactive system is described for facilitating the generation of data bases for flight simulators with high performance characteristics. The automatic generation of digital visual and digital radar scenes requires continuous updating and upgrading. The implementation of a system using a Perkin/Elsser 8/32 with 1 M byte store, a floating point processor and array processor, and standard input and output units is described. A.R.H.

N81-30158# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ESTIMATION OF AERODYNAMIC FORCES ACTING ON EARTH SATELLITES, APPLICATION TO AN EXPERIMENTAL SATELLITE [ESTIMACAO DAS FORCAS AERODINAMICAS EM SATELITES TERRESTRES, APLICACAO A UM SATELITE EXPERIMENTAL]
Valdemir Carrara Nov. 1980 43 p refs In PORTUGUESE; ENGLISH summary
(INPE-1944-RPE/262) Avail: NTIS HC A03/MF A01

The forces acting on an artificial satellite are described. Computable expressions are written for them. A subroutine called DRAG, which estimates the forces due to aerodynamic drag acting on a satellite with a general shape, was written. The equations were derived from Boltzmann equation, with a Maxwellian distribution of velocity and using atmospheric parameters. S.F.

N81-30159# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. High-Speed Aero-Performance Branch.
HIGH ANGLE OF ATTACK MISSILE AERODYNAMIC AT MACH NUMBERS 0.30 TO 1.5 Final Report, Mar. 1974 - Apr. 1979
Valentine Dahlem, Jack I. Flaherty, Donald E. Shereda, and Christian E. G. Przirembe (Rutgers Univ., N.J.) Nov. 1980 330 p refs
(AF Proj. 2404)
(AD-A010210; AFWAL-TR-80-3070) Avail: NTIS HC A15/MF A01 CSCL 01/1

Wind tunnel tests of a smooth missile model with several interchangeable nose parts were conducted at subsonic through supersonic speeds at angles of attack from 0 to 180 degrees. Measurements of both surface pressures and total forces and moments were made at a variety of Mach numbers and Reynolds number combinations. Data were supplemented with wake flow field measurements of the impact pressure and flow direction at angles of attack where maximum induced side force was expected to occur. The important variables of the high angle of attack flow phenomena are numerated. The high angle of attack data are analyzed to deduce the vortex shedding location, the vortex strength, and the vortex paths in the wake. Discrete vortex theory is examined as a method which could be modified, based on experimental data, and used to predict the aerodynamic characteristics of missiles to greater accuracy. E.A.K.

N81-30160# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Engineering.
MAXIMUM INFORMATION TRAJECTORY FOR AN AIR TO AIR MISSILE INTERCEPT M.S. Thesis - Texas Univ. at Austin
Stephen Wendell Larson Dec. 1980 80 p refs
(AD-A101497; AFIT-CI-80-68T) Avail: NTIS HC A05/MF A01 CSCL 16/2

This thesis presents a method for finding the trajectory to complete an air-to-air missile intercept which maximizes information. This is accomplished by formulating a parameter optimization problem and using a penalty function-Lagrange multiplier method to solve for the optimal path. The performance index is the trace of the information matrix. This information matrix is derived using an extended Kalman filter formulation, in cartesian coordinates, which makes state estimates based only on angle measurements. The trace operation on the information matrix is used because the trace and the integration operations commute allowing a scalar performance index. Further, reduction in the functional form of the performance index is achieved by weighing the information matrix by the inverse of the measurement power spectral density. This also avoids numerical difficulties near intercept. Author (GRA)

N81-30188# Executive Office of the President, Washington, D.C Office of Science and Technology Policy.
CARBON/GRAPHITE COMPOSITE MATERIAL STUDY Annual Report
15 Jan 1981 122 p refs
(AR-3) Avail: NTIS HC A06/MF A01

A coordinated federal government action plan was announced in January 1978 to study the potential problems arising from the projected increased use of carbon fiber composite materials in civilian applications. The primary concern was the electrical hazard associated with carbon fibers released from burning of carbon fiber composites and disposal of carbon composite waste or worn out parts. The federal government action plan assigned responsibility for various elements of the study to appropriate federal agencies. The third annual report of the Office of Technology Policy (OSTP) contains the final reports of the NASA, DOT, DOE, AND DOC and the progress reports of the EPA, DHHS (NIOSH), DOL (OSHA), and the FEMA. Also included in this report are the findings of the OSTP, the status agency responsibilities, and a list of applicable references. For individual titles, see N81-30189 through N81-30191.

N81-30189*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CARBON/GRAPHITE COMPOSITE MATERIAL STUDY. 3: AGENCY PROGRAM ACTIVITIES. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)
In Executive Office of the President Carbon/Graphite Composite Material Study 15 Jan. 1981 p 6-10 (For primary document see N81-30188 21-24)
Avail: NTIS HC A06/MF A01 CSCL 11D

The accidental release of carbon fibers from civil aircraft and the need for protection of civil aircraft systems from such fibers were studied. It was concluded that the electrical hazard from carbon fibers accidentally released in an aircraft crash fire pose no threat to human life. Overall costs associated with carbon fiber release are predicted to be extremely low. The risk of electrical or electronic failures due to carbon fibers is so minimal that future exploitation of carbon composites in aircraft should be continued. Additional protection of aircraft avionics to guard against carbon fibers is unnecessary. A program to develop alternate materials specifically to overcome the potential electrical hazard is not justified. E.K.

N81-30190*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CARBON/GRAPHITE COMPOSITE MATERIAL STUDY, APPENDIX A AND APPENDIX B
In Executive Office of the President Carbon/Graphite Composite Material Study 15 Jan. 1981 p 48-100 (For primary document

see N81-30188 21-24)
Avail: NTIS HC A06/MF A01 CSCL 11D

A comprehensive assessment of the possible damage to electrical and electronic equipment caused by accidental release of carbon fibers from burning civil aircraft with carbon composite parts was completed. The study concluded that the amount of fiber likely to be released is much lower than initially predicted. Carbon fiber released from an aircraft crash fire was found (from atmospheric dissemination models) to disperse over a much larger area than originally estimated, with correspondingly lower fiber concentrations. Long term redissemination of fiber was shown to be insignificant if reasonable care is exercised in accident cleanup. The vulnerability of electrical equipment to structural fibers in current use was low. Consumer appliances, industrial electronics, and avionics were essentially invulnerable to carbon fibers. Shock hazards (and thus potential injury or death) were found to be extremely unlikely. E.K.

N81-30198# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Drehfluegler.
DEVELOPMENT AND DESIGN OF A LARGE WIND-TURBINE BLADE
Michael Hahn May 1980 26 p refs
(MBB-UD-301/80-OE) Avail: NTIS HC A03/MF A01

The implementation of the mold concept in the fabrication of large blade-structures which require special surface definition and design features is described. These blades are intended for large horizontal axis windmills. Fiber reinforced composite materials produce rotor blades of high aerodynamic quality with very different profiles. It is possible to vary the stiffness of a cross-section with a given contour. Lightning protection features incorporated are described together with the protection characteristics afforded by erosion resistant paint. In the attachment area, the laminate is thickened considerably. The loads are transferred by means of prestressed studs in combination with cylindrical nuts which fit into holes bored in the thickened laminate.
Author (ESA)

N81-30199# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Drehfluegler.
DEVELOPMENT OF A BEARINGLESS HELICOPTER TAIL ROTOR
H. Huber, H. Frommlet, and W. Buchs 11 Aug. 1980 24 p refs Presented at 6th European Rotocraft and Powered Lift Aircraft Forum, Bristol, England, 16-19 Sep. 1980
(MBB-UD-304/80-OE) Avail: NTIS HC A02/MF A01

A composite bearingless tail rotor is discussed which uses fiberglass bending-torsion-flexure to accommodate bending deflections and collective pitch control. The low chordwise stiffness (soft-inplane concept) contributes significantly to low blade stresses, attainment of low control loads, and low weight. The stability of the soft-inplane tailrotor coupled with the airframe modes is emphasized. Two tailrotor configurations, one three-bladed and the other four-bladed, are considered. The technical design approach is discussed as well as the dynamic characteristics, aerolastic stability, loads, and stress concentration. Results of the structural fatigue and frequency survey testing of components and full-scale blade assemblies are included. Expected weight and cost benefits are examined. Author (ESA)

N81-30282# Radian Corp., Austin, Tex.
CHROMATOGRAPHIC SEPARATION OF CONVENTIONAL AND EXPERIMENTAL FUELS Final Technical Report, Sep. 1979 - Jun. 1980
Karl J. Bombaugh, Donald H. Rodgers, and John C. Beltz Oct. 1980 57 p
(Contract F33615-79-C-2083; AF Proj. 2303)
(AD-A101673; RAD-219-030-03; AFWAL-TR-80-2098) Avail: NTIS HC A04/MF A01 CSCL 21/4

This research was performed in order to develop a chromatographic method for the separation and isolation of the various classes of hydrocarbons present in conventional and experimental aircraft fuels. The objective of such a technique is to provide a convenient means of estimating the relative proportions of the hydrocarbon classes, i.e., normal and branched alkanes, alkylbenzenes, alkenes, etc., and to render the initially complex fuels tractable to conventional methods of analysis and characterization. The procedure developed consists of a semi-preparative column chromatographic method, using spherical particulate silica gel column packing and isobutane as the mobile phase. The fuel samples are fractionated by passing them through the column and collecting the eluting fractions at regular intervals. The volatile isobutane carrier is evaporated from the fractions and the residues are analyzed by techniques such as gas chromatography. Because the isobutane vaporizes quantitatively at low temperatures, the fractions are obtained free of interfering solvent. In this respect, the technique is novel and unprecedented. Results of the analyses show that the method provides good separation of aliphatic and aromatic hydrocarbons, and partial resolution of aliphatic and olefinic hydrocarbons. Resolution may be improved substantially by optimizing the column temperature and by using low-boiling mobile phases of varying polarity. GRA

N81-30313# Oak Ridge National Lab., Tenn.
A MATRIX APPROACH TO BIOLOGICAL INVESTIGATION OF SYNTHETIC FUELS
David L. Coffin Mar. 1981 79 p refs Conf. held at Research Triangle Park, N.C., 26 Apr. 1979; sponsored by EPA and DOE
(PB81-183477; EPA-600/9-81-009) Avail: NTIS HC A05/MF A01 CSCL 06T

Documentation is provided for a conference on toxicological assessment of health effects from the rapidly developing synthetic fuels industry. The discussions focus on the Paraho crude shale oil produced and refined into diesel and jet fuels. Summaries of both operations are presented. Also discussed is the collection, storage, and distribution to toxicologists of sample materials from these operations. GRA

N81-30331# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TRANSVERSE VOICE RADIO LINK FOR STRATOSPHERIC BALLOONS [RADIOENLACE DE VOZ ATRAVES DE BALAO ESTRATOSFERICOS]
Etiene Monteiro Schneider Jan. 1981 14 p refs In PORTUGUESE; ENGLISH summary Presented at the 23nd Ann. Meeting of SBPC
(INPE-1992-RPE/285) Copyright. Avail: NTIS HC A02/MF A01

A three-way communication system between a scientific balloon, aircraft, and ground tracking station is described. The balloon payload, which flies at an altitude of 40 km, is used as an active repeater. The system uses links already existing in this kind of flight: telecommand, telemetry, and radio localization. The signal from the ground station comes to the balloon through the telecommand link, is sent to the aircraft through the radio localization link. The signal from the aircraft comes to the balloon through the telecommand link and is sent to the ground station through the telemetry link. Aircraft and ground station use a normal VHF communication link. J.D.H.

N81-30338# AMAF Industries, Columbia, Md.
IMPACT OF LOW ALTITUDE COVERAGE REQUIREMENTS ON AIR-GROUND COMMUNICATIONS Final Report, Aug 1980 - Mar. 1981
B. Magenheim Washington FAA 31 Mar. 1981 93 p
(Contract DOT-FA78WAI-830)
(AD-A101642; FAA-RD-81-9) Avail: NTIS HC A05/MF A01 CSCL 17/2

A representative area of Appalachia surrounding Charleston, West Virginia is analyzed in terms of existing helicopter traffic patterns and communications facilities. Traffic patterns were established from telephone interviews with pilots flying this area regularly. Communications coverage was established from computer generated coverage contours obtained from the Electromagnetic Compatibility Analysis Center (ECAC) and verified by pilot interviews and one flight test (as reported by the FAA Technical Center). Techniques for improving coverage are discussed. These include two new remote communication outlets located in the mountains west and south of Beckley, W. Va., a high gain antenna at Charleston pointed in a southerly direction, the use of mobile radio telephone to permit pilots to access nearby telephone facilities when on the ground at a remote site, short range less than 150 miles, hf radio, and a discrete frequency for exclusive use by low-flying aircraft. FAA activities directed at improving communications to helicopter flying to and from offshore oil and gas platforms in the Gulf of Mexico is presented in an Appendix. Author (GRA)

N81-30388*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.

HADY-1, A FORTRAN PROGRAM FOR THE COMPRESSIBLE STABILITY ANALYSIS OF THREE-DIMENSIONAL BOUNDARY LAYERS
Nabil M. El-Hady *In its* Appl. of Stability Theory of Laminar Control Sep. 1981 22 p

Avail: NTIS HC A04/MF A01 CSCL 20D

A computer program, HADY-1, is described for calculating the linear incompressible or compressible stability characteristics of the laminar boundary layer on swept and tapered wings. The eigenvalue problem and its adjoint arising from the linearized disturbance equations with the appropriate boundary conditions are solved numerically using a combination of the Newton-Raphson iterative scheme and a variable step size integrator based on the Runge-kutta-Fehlburg fifth-order formulas. The integrator is used in conjunction with a modified Gram-Schmidt orthonormalization procedure. E.D.K

N81-30389*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
THE EFFECT OF BOUNDARY LAYER GROWTH ON THE STABILITY OF COMPRESSIBLE FLOWS
Nabil M. El-Hady *In its* Appl. of Stability Theory of Laminar Flow Control Sep. 1981 10 p refs

Avail: NTIS HC A04/MF A01 CSCL 20D

The method of multiple scales is used to describe a formally correct method based on the nonparallel linear stability theory that examines the two and three dimensional stability of compressible boundary layer flows. The method is applied to the supersonic flat plate boundary layer at Mach number 4.5. The theoretical growth rates are in good agreement with the experimental results of Kendall. The method is also applied to the infinite span swept wing transonic boundary layer with suction to evaluate the effect of the nonparallel flow on the development of crossflow disturbances. Author

N81-30392*# Illinois Inst. of Tech., Chicago.
MODIFICATION IN DRAG OF TURBULENT BOUNDARY LAYERS RESULTING FROM MANIPULATION OF LARGE-SCALE STRUCTURES Interim Report
T. C. Corke, Y. Guezennec, and H. M. Nagib Washington NASA Jul. 1981 28 p refs
(Grant NsG-1591)
(NASA-CR-3444) Avail: NTIS HC A03/MF A01 CSCL 20D

The effects of placing a parallel-plate turbulence manipulator in a boundary layer are documented through flow visualization and hot wire measurements. The boundary layer manipulator was designed to manage the large scale structures of turbulence leading to a reduction in surface drag. The differences in the turbulent structure of the boundary layer are summarized to demonstrate differences in various flow properties. The manipulator inhibited the intermittent large scale structure of the turbulent boundary layer for at least 70 boundary layer thicknesses downstream. With the removal of the large scale, the streamwise turbulence intensity levels near the wall were reduced. The downstream distribution of the skin friction was also altered by the introduction of the manipulator. J.D.H.

N81-30454# Imperial Coll. of Science and Technology, London (England). Heat Transfer Section.
COMPUTER MODELING OF INTERNAL COMBUSTION ENGINES: COMBUSTION AND RELATED PROCESSES
D. B. Spalding Jun. 1979 37 p refs
(HTS/79/3) Avail: NTIS HC A03/MF A01

Gas-flow, heat transfer and chemical-reaction processes taking place in the internal combustion (IC) cylinder are studied. Two-phase processes in the inlet manifold are examined together with the possibility of calculating spark-ignition processes, using a computer model. Other problems investigated include predicting the rate of propagation of turbulent flames, and studying the situation when the rate of combustion is determined by the mixing of two bodies of gas of differing fuel-air ratio, either with or without the additional influence of chemical kinetics. Two-phase processes, the quenching of gases, and exhaust processes are also examined. It is argued that the advent of economical three-dimensional computer programs has significantly increased the extent to which the design of IC engines can optimize designs. Author (ESA)

N81-30469*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SOME EXPERIENCES WITH ACTIVE CONTROL OF AEROELASTIC RESPONSE
Jerry R. Newsom and Irving Abel Jul. 1981 19 p refs
(NASA-TM-83179) Avail: NTIS HC A02/MF A01 CSCL 20K

Flight and wind tunnel tests were conducted and multidiscipline computer programs were developed as part of investigations of active control technology conducted at the NASA Langley Research Center. Unsteady aerodynamics approximation, optimal control theory, optimal controller design, and the Delta wing and DC-10 models are described. The drones for aerodynamics and structural testing (DAST program) for evaluating procedures for aerodynamic loads prediction and the design of active control systems on wings with significant aeroelastic effects is described as well as the DAST model used in the wind tunnel tests. A.R.H.

N81-30476# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
AEROELASTIC FLUTTER AND DIVERGENCE OF GRAPHITE/EPOXY CANTILEVERED PLATES WITH BENDING-TORSION STIFFNESS COUPLING M.S. Thesis
Steven James Hollowell Jan. 1981 139 p refs
(AD-A101726; AFIT-CI-80-67T) Avail: NTIS HC A07/MF A01 CSCL 20/4

The aeroelastic flutter and divergence behavior of rectangular, graphite/epoxy, cantilevered plates with varying amounts of bending torsion stiffness coupling is investigated for incompressible flow. A general Rayleigh-Ritz formulation is used to calculate flexibility influence coefficients, static deflections, divergence velocities, vibration frequencies, and flutter velocities. Flutter calculations are done using the U-g method. Test plates were constructed and subjected to static, vibration and wind tunnel tests. Wind tunnel tests indicated static deflections, divergence instabilities, bending torsion flutter at low angles of attack, and stall flutter at high angles of attack. Bending stiffness and first bending frequencies showed good agreement between theory and experiment. Torsional stiffness and first torsion frequencies were not accurately predicted by the theory for highly coupled plates. Divergence velocities and reduced flutter velocities showed reasonable agreement between theory and experiment. Test plates with varying amounts of coupling exhibited markedly different stal flutter characteristics. GRA

N81-30485# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Drehfluegler.
FATIGUE TESTING OF COMPOSITE ROTOR BLADES
F. Och 12 Sep. 1980 17 p refs Presented at 51st AGARD Struct. and Mater. Panel on Helicopter Fatigue Life Assessment, Aix-en-Provence, France, 14-19 Sep. 1980
(MBB-UD-308/80-OE) Avail: NTIS HC A02/MF A01

Nonlinear regression analysis used with an equation of Weibull with four material-dependent parameters is employed to derive mean and working S/N curves for strength and endurance determinations. The corresponding scattering factor is calculated from the fatigue failure load for a given number of cycles. The fatigue test program makes use of test coupons cut out of production blades to establish basic S/N curve shapes for fiber and matrix failures. Coupon testing included studying temperature/humidity preconditioning effects, as well as the effect of test temperature and in-service operation on the fatigue strength of unidirectional glass fiber composites. Full scale fatigue tests were conducted with root end and air foil sections. These tests included investigating effects of ballistic impact damage and long-term exposure to different climatic conditions. It is shown that the S/N curve shapes and scattering factors determined from coupon data can be applied to full scale specimens. Author (ESA)

N81-30525*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PARABOLIC DISH SOLAR THERMAL POWER ANNUAL PROGRAM REVIEW PROCEEDINGS
Herb J. Holbeck 1 May 1981 277 p refs Proceedings of conf. held in Pasadena, Calif., 13-15 Jan. 1981
(Contracts NAS7-100; DE-AT04-81AL-16228)
(NASA-CR-164696; JPL-Pub-81-44; DOE/JPL-1060-46; JPL-5105-83) Avail: NTIS HC A13/MF A01 CSCL 10A

The development and testing of concentrators, receivers, and power conversion units are reported. System design and development for engineering experiments are described. Economic analysis and market assessments for advanced development activities are discussed. Technology development issues and application/user needs are highlighted.

N81-30529*# Garrett Turbine Engine Co., Phoenix, Ariz.
SOLAR BRAYTON ENGINE/ALTERNATOR SET
L. Six and R. Elkins *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 23-35

Avail: NTIS HC A13/MF A01 CSCL 10B

Work on the Mod O solar Brayton engine/alternator set is redirected to utilize solarized components of the automotive advanced gas turbine (AGT). The new configuration is referred to as the Mod I. Commercialization of solar Brayton engines thus should be enhanced not only by relating the design to an engine expected to reach the high quantity, low cost production rates associated with the automotive market, but also by the potential the AGT components provide for growth of efficiency and power rating. This growth would be achieved through use of ceramics in later versions making operation possible at temperatures up to 2500 F. The longer program duration and higher cost of the Mod I is considered. T.M.

N81-30530*# United Sterling, Inc. Alexandria, Va. Concept Analysis Dept.
FIRST PHASE TESTING OF SOLAR THERMAL ENGINE AT UNITED STIRLING
Worth Percival and Hans-Goeran Nelving *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 37-44 refs

Avail: NTIS HC A13/MF A01 CSCL 10B

The objective of the program is to demonstrate that the Stirling engine is a practical efficient and reliable energy converter when integrated with a parabolic dish concentrator, and that it has the potential of being cost competitive with fossil fueled electric generating systems of today. The engine, with its receiver (solar heat exchanger), alternator and control system, is described. T.M.

N81-30531*# Fairchild Stratos Corp., Manhattan Beach, Calif.
NON-HEAT PIPE RECEIVER/P-40 STIRLING ENGINE
Richard A. Haglund *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 47-50

Avail: NTIS HC A13/MF A01 CSCL 10A

The technology for a full-up hybrid dish-Stirling Solar Thermal Power system is discussed. Overall solar-to-electric efficiency for the dish-Stirling system demonstration is approximately 30%. Hybrid operation is provided by fossil fuel combustion augmentation, which enables the Stirling engine to operate continuously at constant speed and power, regardless of insolation level, thus providing the capability to operate on cloudy days and at night. T.M.

N81-30532*# General Electric Co., Evendale, Ohio. Advanced Energy Programs Dept.
HEAT PIPE SOLAR RECEIVER WITH THERMAL ENERGY STORAGE
W. F. Zimmerman *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 51-56

Avail: NTIS HC A13/MF A01 CSCL 10A

An HPSR Stirling engine generator system featuring latent heat thermal energy storge, excellent thermal stability and self regulating, effective thermal transport at low system delta T is described. The system was supported by component technology testing of heat pipes and of thermal storage and energy transport models which define the expected performance of the system. Preliminary and detailed design efforts were completed and manufacturing of HPSR components has begun. T.M.

N81-30562*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TEST RESULTS OF THE CHRYSLER UPGRADED AUTOMOTIVE GAS TURBINE ENGINE: INITIAL DESIGN Final Report
David Horvath, Guy H. Ribble, Jr., Edward L. Warren, and James C. Wood Jul. 1981 66 p refs
(Contract DE-AI01-77CS-51040)
(NASA-TM-81660; DOE/NASA/51040-22; E-676) Avail: NTIS HC A04/MF A01 CSCL 10B

The upgraded engine as built to the original design was deficient in power and had excessive specific fuel consumption. A high instrumented version of the engine was tested to identify the sources of the engine problems. Analysis of the data shows the major problems to be low compressor and power turbine efficiency and excessive interstage duct losses. In addition, high HC and CO emission were measured at idle, and high NOx emissions at high energy speeds. T.M.

N81-30615# Sandia Labs., Albuquerque, N. Mex. Advanced Energy Projects Div.
RECENT DARRIEUS VERTICAL-AXIS WIND TURBINE AERODYNAMICAL EXPERIMENTS AT SANDIA NATIONAL LABORATORIES
Paul C. Klimas 1981 8 p refs Presented at the 2nd DOE/NASA Wind Turbine Dyn. Workshop, Cleveland, 24 Feb. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1108C; CONF-810226-5) Avail: NTIS HC A02/MF A01

The aerodynamics of airfoils operating in the vertical axis wind turbine (VAWT) environment were examined. The experiments are intended to reduce VAWT cost of energy an increase system reliability. The experiments include: (1) chordwise pressure surveys; (2) circumferential blade acceleration surveys; (3) effects of blade camber; (4) pitch and offset; (5) blade blowing; and (6) use of sections designed specifically for VAWT application. DOE

N81-30659# Army Construction Engineering Research Lab., Champaign, Ill.
COMMUNITY REACTION TO IMPULSE NOISE: INITIAL ARMY SURVEY Final Report
Paul D. Schomer Jun. 1981 172 p refs
(DA Proj. 4A7-62720-A-896)
(AD-A101674; CERL-TR-N-100) Avail: NTIS HC A08/MF A01 CSCL 01/3

This report gives the results of a noise-impact attitudinal survey done in the Fort Bragg/Fayetteville, NC, area. It shows that to the extent normal sources like airplanes fit an energy model (such as the day/night average sound level (DNL), impulse noise also fits an energy model. The growth of annoyance levels in a community with increases of loudness occurs similarly for impulse noise and for aircraft and helicopters. The growth of annoyance in a community with increases in the frequency of occurrence of events occurs in a similar way for all noises, except that the integration period for impulse noise apparently extends down to 'once every few months', whereas annoyance all but dies away for other noises when the frequency of occurrence drops this low. All types of noise sources have roughly the same nighttime noise penalty: 7 to 10 dB. C-weighting is the best available standard measure; a C-weighted DNL (CDNL) which includes no threshold or impulse correction factor offers the best model to describe community response. To establish an equivalency between CDNL levels used to assess impulse noise and A-weighted DNL (ADNL) levels used to assess other noise, it is necessary to find a common denominator. It is recommended that the percent of the community 'highly annoyed' in a given noise climate be that common denominator. With this common denominator, about 6 dB must be added to the numerical value of the CDNL level. Author (GRA)

N81-30700# Acurex Corp., Mountain View, Calif. Energy and Environmental Div.
PROCEEDINGS OF THE 4TH WORKSHOP ON CATALYTIC COMBUSTION Report, Sept. 1978 - May 1980
John P. Kesselring, comp. Aug. 1980 561 p refs Workshop held at Cincinnati, 14-15 May 1980
(Contract EPA-68-02-3122)
(PB81-176067; EPA-600/9-80-035; IERL-RTP-1077) Avail: NTIS HC A24/MF A01 CSCL 13B

The results of recent research in the areas of catalyst performance, components and applications of catalytic combustion

systems, and the use of alternative fuels in catalytic combustors were presented. The current state of the art in the application of catalyst systems for pollution control and performance improvement are discussed. Applications include fire tube and water tube boilers, and gas turbines for utility, industrial, automotive, and aircraft systems. GRA

N81-30774 Michigan Univ., Ann Arbor.
DETERMINATION OF WIND STRESS FROM WATER LEVEL FLUCTUATIONS Ph.D. Thesis
David John Schwab 1981 117 p
Avail: Univ. Microfilms Order No. 8116331

An inverse method is tested in several ideal cases and is applied to observations of Lake Erie water levels and over-water wind to compute over-water drag coefficients. The method is based on the linearized, vertically-integrated shallow water equations with rotation and friction terms. It is shown that the free surface fluctuation can be expressed as the convolution integral of time and space dependent wind stress with a response function kernel. An explicit form for the response function in terms of the normal modes of the system is given. If wind stress is taken as the unknown and water level fluctuation as a prescribed quantity, the integral equation relating them does not have a unique solution. However, it is shown that, with some reasonable assumptions about the spatial variability of the wind stress field, a unique solution for wind stress in terms of water level fluctuations can be obtained. Dissert. Abstr.

N81-30815*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
USER'S MANUAL FOR FSLIP-3, FLEXSTAB LOADS INTEGRATION PROGRAM
Robert L. Sims Aug. 1981 116 p refs
(NASA-TM-81364; H-1158) Avail: NTIS HC A06/MF A01 CSCL 09B

The FSLIP program documentation and user's manual is presented. As a follow on program to the FLEXSTAB computer analysis system, the primary function of this FORTRAN IV program is to integrate panel pressure coefficients computed by FLEXSTAB to obtain total shear, bending, and torque airloads on various surfaces, summed relative to user specified axes. The program essentially replaces the ALOADS module in FLEXSTAB with expanded capabilities and flexibility. As such, FSLIP is generalized to work on any FLEXSTAB model or other pressure data if in a compatible format. J.D.H.

N81-30851*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A METHOD FOR OBTAINING REDUCED-ORDER CONTROL LAWS FOR HIGH-ORDER SYSTEMS USING OPTIMIZATION TECHNIQUES
Vivek Mukhopadhyay, Jerry R. Newsom, and Irving Abel Aug. 1981 66 p refs
(NASA-TP-1876; L-14355) Avail: NTIS HC A04/MF A01 CSCL 12A

A method of synthesizing reduced-order optimal feedback control laws for a high-order system is developed. A nonlinear programming algorithm is employed to search for the control law design variables that minimize a performance index defined by a weighted sum of mean-square steady-state responses and control inputs. An analogy with the linear quadractic Gaussian solution is utilized to select a set of design variables and their initial values. To improve the stability margins of the system, an input-noise adjustment procedure is used in the design algorithm. The method is applied to the synthesis of an active flutter-suppression control law for a wind tunnel model of an aeroelastic wing. The reduced-order controller is compared with the corresponding full-order controller and found to provide nearly optimal performance. The performance of the present method appeared to be superior to that of two other control law order-reduction methods. It is concluded that by using the present algorithm, nearly optimal low-order control laws with good stability margins can be synthesized. M.G.

N81-30907*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONDITIONED PRESSURE SPECTRA AND COHERENCE MEASUREMENTS IN THE CORE OF A TURBOFAN ENGINE
Allen Karchmer 1981 10 p refs Presented at 7th Aeroelastic Conf., Palo Alto, Calif., 5-7 Oct. 1981; sponsored by AIAA
(NASA-TM-82688; E-970; AIAA-Paper-81-2052) Avail: NTIS HC A02/MF A01 CSCL 20A

Multiple and partial coherence functions and the corresponding conditioned coherent output spectra are computed between fluctuating pressures measured at two locations within the tailpipe of a turbofan engine and far-field acoustic pressure. The results are compared with the ordinary coherent output spectrum as obtained between a single tailpipe pressure measurement and the far-field acoustic pressure. The comparison indicates apparent additional 'coherent output' (i.e., core-noise) beyond that detectable with an ordinary coherent measurement, thus suggesting the tailpipe as a core-noise source region. Further evidence suggests, however, that these differences may be attributed to the presence of transverse acoustic modes in the tailpipe and that the tailpipe is not, in fact, a significant source region. Author

N81-30908*# Lockheed-Georgia Co., Marietta.
SHOCK ASSOCIATED NOISE REDUCTION FROM INVERTED-VELOCITY-PROFILE COANNULAR JETS Final Report
H. K. Tanna, C. K. W. Tam, and W. H. Brown Aug. 1981 161 p refs
(Contract NAS1-15971)
(NASA-CR-3454; LG81ER0162) Avail: NTIS HC A08/MF A01 CSCL 20A

Acoustic measurements show that the shock noise from the outer stream is virtually eliminated when the inner stream is operated at a Mach number just above unity, regardless of all the other jet operating conditions. At this optimum condition, the coannular jet provides the maximum noise reduction relative to the equivalent single jet. The shock noise reduction can be achieved at inverted-as well as normal-velocity-profile conditions, provided the coannular jet is operated with the inner stream just slightly supersonic. Analytical models for the shock structure and shock noise are developed indicate that a drastic change in the outer stream shock cell structure occurs when the inner stream increases its velocity from subsonic to supersonic. At this point, the almost periodic shock cell structure of the outer stream nearly completely disappears the noise radiated is minimum. Theoretically derive formulae for the peak frequencies and intensity scaling of shock associated noise are compared with the measured results, and good agreement is found for both subsonic and supersonic inner jet flows. A.R.H.

N81-30910# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.
NOISE ABATEMENT TECHNOLOGY OPTIONS FOR CONVENTIONAL TURBOPROP AIRPLANES Final Report
William J. Galloway and John F. Wilby Jun. 1981 115 p refs
(Contract DOT-FA78WAI-4190)
(AD-A101828; BBN-4220; FAA-EE-80-19) Avail: NTIS HC A06/MF A01 CSCL 20/1

The practical application of noise control technology to new and derivative conventional turboprop airplanes likely to come into service in the 1980's has been analyzed with a view to determining noise control cost/benefits. The analysis identifies feasible noise control methods, applies them to four study airplanes, and presents the noise reductions in terms of the equivalent perceived noise level at takeoff, sideline and approach locations, and the effect on the area within selected EPNL contours. Noise reductions of up to 8.3 dB for takeoff and 10.7 dB for approach are calculated for the study airplanes but, for most cases, the changes are less than 5 dB. Weight and cost increases associated with the noise control treatments are determined under the assumption that they are no changes to airplane performance or fuel consumption. Author (GRA)

N81-30911# Boeing Vertol Co., Philadelphia, Pa.
IMPACT OF PREDICTION ACCURACY ON COSTS - NOISE TECHNOLOGY APPLICATIONS IN HELICOPTERS Final Report
R. H. Spencer and J. Sternfeld, Jr. Jun. 1981 49 p refs
(Contract DOT-FA78WA-4161)
(AD-A101768; FAA/EE-81-10) Avail: NTIS HC A03/MF A01 CSCL 20/1

This study is an extension of the work reported in AD-A083 935, and considers the effect which uncertainties in the prediction and measurement of helicopter noise have on the development and operating costs. Although the number of helicopters studied

is too small to permit generally applicable conclusions, the following are the primary results: (1) the Effective Perceived Noise (EPN) Levels tended to be overpredicted for takeoffs, underpredicted for approaches, with no general trend noted for level flyovers; (2) prediction accuracy for the cases studied ranged from 1 to 6 EPNdB; and (3) test and measurement repeatability can give a range of up to 3 EPNdB. Each helicopter must be studied as an individual case and generalization of cost trends should be avoided. GRA

N81-30962*# Hughes Research Labs., Malibu, Calif.
DEFINITION, ANALYSIS AND DEVELOPMENT OF AN OPTICAL DATA DISTRIBUTION NETWORK FOR INTEGRATED AVIONICS AND CONTROL SYSTEMS Final Report, Jun. 1979 - May 1980
Ronnie R. Burns Aug. 1981 152 p refs
(Contract NAS1-15829)
(NASA-CR-159370) Avail: NTIS HC A08/MF A01 CSCL 20F

The potential and functional requirements of fiber optic bus designs for next generation aircraft are assessed. State-of-the-art component evaluations and projections were used in the system study. Complex networks were decomposed into dedicated structures, star buses, and serial buses for detailed analysis. Comparisons of dedicated links, star buses, and serial buses with and without full duplex operation and with considerations for terminal to terminal communication requirements were obtained. This baseline was then used to consider potential extensions of busing methods to include wavelength multiplexing and optical switches. Example buses were illustrated for various areas of the aircraft as potential starting points for more detail analysis as the platform becomes definitized. M.G.

N81-31030# Committee on Science and Technology (U. S. House).
NASA AUTHORIZATION, 1982, VOLUME 4
Washington GPO 1981 1248 p Hearings before the Subcomm. on Space Sci. and Appl. of the Comm. on Sci. and Technol., 97th Congr., 1st Sess., No. 7, 28 Jan., 20, 23, 27 Feb., and 2, 4-5, 10-11 Mar. 1981
(GPO-79-432-Vol-4) Avail: Subcommittee on Space Science and Applications

Progress and accomplishments of the year are reviewed and requests for funding are examined in the areas of space sciences, shuttle related activities, space flight operations, a space applications, and aeronautics. The numerical aerodynamics simulation which will reduce the cost of aircraft design, chemical propulsion, large space structures, power systems, information systems, and the Venus Orbiting Imaging Radar spacecraft are discussed. Space processing, Spacelab payloads, and possible space shuttle configurations are also examined. A.R.H.

N81-31104# Air Force Human Resources Lab., Brooks AFB, Tex. Logistics and Technical Training Div.
ACTUAL VERSUS SIMULATED EQUIPMENT FOR AIRCRAFT MAINTENANCE TRAINING: COST IMPLICATIONS OF THE INCREMENTAL VERSUS THE UNIQUE DEVICE Final Report
Richard E. Vestewig and F. Thomas Eggemeier Jul. 1981 18 p refs Presented at the 23rd Ann. Meeting of the Human Factors Soc., 1979
(AF Proj. 1710)
(AD-A102388; AFHRL-TP-81-17) Avail: NTIS HC A02/MF A01 CSCL 14/1

Life cycle cost estimates were developed for use of simulated test equipment vs actual test equipment in a maintenance training program of the type used for current advanced fighter aircraft. Previous life cycle cost comparisons had not explicitly considered the cost implications of procurement and support of a unique training device vs an incremental device. This effort included the unique vs the incremental device factor. Total estimated fifteen year costs for simulated equipment trainers were significantly lower than comparable estimates for actual equipment trainers. The results indicate that the cost implications of a unique device vs an incremental device are important determinants of both acquisition and support cost estimates and should be considered fully in future life cycle costing efforts. Author (GRA)

N81-31105# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
DYNAMIC STABILITY PARAMETERS
May 1981 389 p refs Lecture Series held at Moffett Field, Calif., 2-5 Mar. 1981 and Rhode-Saint-Genese, Belgium, 16-19 Mar. 1981; sponsored in part by the von Karman Inst. for Fluid Dynamics
(AGARD-LS-114; ISBN-92-835-1385-1) Avail: NTIS HC A17/MF A01

The impact of high angle of attack aerodynamics on dynamic stability characteristics of aerospace vehicles is reviewed. Analytical, wind tunnel, and flight test techniques used are surveyed.

N81-31106*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMIC MATHEMATICAL MODELING - BASIC CONCEPTS
Murray Tobak and Lewis B. Schiff *In* AGARD Dyn. Stability Parameters May 1981 31 p refs

Avail: NTIS HC A17/MF A01

The mathematical modeling of the aerodynamic response of an aircraft to arbitrary maneuvers is reviewed. Bryan's original formulation, linear aerodynamic indicial functions, and superposition are considered. These concepts are extended into the nonlinear regime. The nonlinear generalization yields a form for the aerodynamic response that can be built up from the responses to a limited number of well defined characteristic motions, reproducible in principle either in wind tunnel experiments or flow field computations. A further generalization leads to a form accommodating the discontinuous and double valued behavior characteristics of hysteresis in the steady state aerodynamic response. J.D.H.

N81-31107*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
IMPACT OF HIGH-ALPHA AERODYNAMICS ON DYNAMIC STABILITY PARAMETERS OF AIRCRAFT AND MISSILES

Gerald N. Malcolm *In* AGARD Dyn. Stability Parameters May 1981 18 p refs
Avail: NTIS HC A17/MF A01 CSCL 01A

The aerodynamic phenomena associated with high angles of attack and their effects on the dynamic stability characteristics of airplane and missile configurations are examined. Information on dynamic effects is limited. Steady flow phenomena and their effects on the forces and moments are reviewed. The effects of asymmetric vortices and of vortex bursting on the dynamic response of flight vehicles are reviewed with respect to their influence on: (1) nonlinearity of aerodynamic coefficients with attitude, rates, and accelerations; (2) cross coupling between longitudinal and lateral directional models of motion; (3) time dependence and hysteresis effects (4) configuration dependency; and (5) mathematical modeling of the aerodynamics. Author

N81-31108# National Aeronautical Establishment, Ottawa (Ontario). Unsteady Aerodynamics Lab.
REVIEW OF TECHNIQUES FOR DETERMINATION OF DYNAMIC STABILITY PARAMETERS IN WIND TUNNELS

K. J. Orlik-Rueckemann *In* AGARD Dyn. Stability Parameters May 1981 28 p refs

Avail: NTIS HC A17/MF A01

The basic principles of various methods of wind tunnel testing and the practical aspects of various techniques are discussed and illustrated by examples, descriptions, and sketches of existing apparatuses. Methods of measuring dynamic derivatives are reviewed. The measurement of reactions and of motion, rotary and half model techniques, derivatives due to translational acceleration and pure rotation, free model techniques, and control surface oscillation techniques are considered. J.D.H.

N81-31109# National Aeronautical Establishment, Ottawa (Ontario). Unsteady Aerodynamics Lab.
DIRECT FORCED-OSCILLATION TECHNIQUES FOR THE DETERMINATION OF STABILITY DERIVATIVES IN WIND TUNNELS
E. S. Hanff *In* AGARD Dyn. Stability Parameters May 1981 23 p refs

Avail: NTIS HC A17/MF A01

The current state-of-the-art in the field of stability parameters measurement in wind tunnels using the direct forced oscillation technique is discussed. The principles on which the technique is based, and some typical wind tunnel apparatuses and instrumentation systems are briefly described. A rather detailed description of the data reduction procedures used at NAE to obtain both direct as well as cross and cross-coupling derivatives is given. An advanced dynamic calibrator with which the validity of the experimental and analytical procedures can be independently verified is described. Author

N81-31110# Royal Aircraft Establishment, Bedford (England). Dept. of Aerodynamics.

WIND-TUNNEL MEASUREMENT OF AERODYNAMIC DERIVATIVES USING FLEXIBLE-STING RIGS

C. O. OLeary *In* AGARD Dyn. Stability Parameters May 1981 15 p refs

Avail: NTIS HC A17/MF A01

Forced oscillation, flexible sting rigs are used by several establishments for wind tunnel measurement of aerodynamic derivatives. This paper describes the two multi-degree of freedom rigs at RAE Bedford and DFVLR. Aircraft models are mounted on stings with built in flexures and oscillations are excited in 2 or 3 degrees of freedom. The response is measured using strain gauges on the sting flexures. Measurements of lateral or longitudinal derivatives can be made. Details are given of the apparatus, technique and method of analysis. Current modifications to the RAE rig actuating system are described and differences in the RAE and DFVLR rigs are discussed. Results are presented, from low speed high angle of attack tests on a combat aircraft model which were made with a new semicircular sting support facility which allows testing up to an angle of 90 deg. A comparison is made of the derivative data from wind tunnel tests, the corresponding data from flight tests and some theoretical estimates for two configurations: a jet trainer and a transport aircraft. Author

N81-31111*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ROTARY AND MAGNUS BALANCES

Gerald N. Malcolm *In* AGARD Dyn. Stability Parameters May 1981 26 p refs

Avail: NTIS HC A17/MF A01 CSCL 01A

Two wind tunnel techniques for determining part of the aerodynamic information required to describe the dynamic bahavior of various types of vehicles in flight are described. Force and moment measurements are determined with a rotary-balance apparatus in a coning motion and with a Magnus balance in a high-speed spinning motion. Coning motion is pertinent to both aircraft and missiles, and spinning is important for spin stabilized missiles. Basic principles of both techniques are described, and specific examples of each type of apparatus are presented. Typical experimental results are also discussed. Author

N81-31112*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CURVED-FLOW, ROLLING-FLOW, AND OSCILLATORY PURE-YAWING WIND-TUNNEL TEST METHODS FOR DETERMINATION OF DYNAMIC STABILITY DERIVATIVES

Joseph R. Chambers, Sue B. Grafton, and Frederick H. Lutze (Virginia Polytechnic Inst. and State Univ.) *In* AGARD Dyn. Stability Parameters May 1981 13 p refs

Avail: NTIS HC A17/MF A01 CSCL 01A

The test capabilities of the Stability Wind Tunnel of the Virginia Polytechnic Institute and State University are described, and calibrations for curved and rolling flow techniques are given. Oscillatory snaking tests to determine pure yawing derivatives are considered. Representative aerodynamic data obtained for a current fighter configuration using the curved and rolling flow techniques are presented. The application of dynamic derivatives obtained in such tests to the analysis of airplane motions in general, and to high angle of attack flight conditions in particular, is discussed. J.D.H.

N81-31113# Lockheed Missiles and Space Co., Sunnyvale, Calif.

SUPPORT INTERFERENCE

L. E. Ericsson *In* AGARD Dyn. Stability Parameters May 1981 26 p refs

Avail: NTIS HC A17/MF A01

The existing information about support interference is reviewed, with particular emphasis on dynamic interference effects and the special problems encountered at high angles of attack. Support interference effects are much more severe in dynamic than in static tests. The support interference is aggravated by a boat-tail or dome shaped base, or even by modest base shoulder roundness. The general conclusion is that asymmetric stings or sting-strut combinations should be avoided. For slender bodies at low angles of attack a transverse rod comes close to permitting the true dynamically destabilizing effect of a bulbous base to be measured whereas even a very slender sting will distort the near wake effect and produce an unconservatively high measure of the dynamic stability. At intermediate and high angles of attack the sting support is superior to the other support methods. In many cases half-model testing provides the means of avoiding most of the support interference effects. In some cases, as for a short blunt body such as the Viking configuration, the best approach appears to be to allow sting plunging, using a very slender sting. J.D.H.

N81-31114# National Aeronautical Establishment, Ottawa (Ontario). Unsteady Aerodynamic Lab.

APPLICATIONS OF HALF-MODEL TECHNIQUE IN DYNAMIC STABILITY TESTING

E. S. Hanff *In* AGARD Dyn. Stability Parameters May 1981 11 p refs

Avail: NTIS HC A17/MF A01

The applications of the half model technique to oscillatory wind tunnel experiments are considered. The practical advantages and disadvantages of using the half model technique for dynamic stability testing are briefly stated and compared with those of its full model counterpart. Examples are given of various wind-tunnel dynamic experiments for which the half model technique is particularly suitable. Descriptions of pitching, plunging and dynamic calibrating apparatuses are given as well as a brief review of the data analysis required for the determination of direct derivatives using the free and forced oscillation technique. Methods of obtaining cross derivatives in the longitudinal plane are also indicated. J.D.H.

N81-31115# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

DETERMINATION OF AIRCRAFT DYNAMIC STABILITY AND CONTROL PARAMETERS FROM FLIGHT TESTING

P. G. Hamel *In* AGARD Dyn. Stability Parameters May 1981 42 p refs

Avail: NTIS HC A17/MF A01

The present state of the art of aircraft parameter identification (PI) techniques from flight test data and appraisal of current methods developed and applied to various aircraft configurations and flight conditions are reviewed. Practical aspects and results of PI techniques are emphasized. This is especially relevant for data correlation and for increasing confidence in static and dynamic wind tunnel prediction techniques. Recent experience for fixed and rotary wing aircraft PI are presented as well as identification results for extreme flight regimes. Information on pilot in the loop and closed loop aspects of aircraft PI are given with special reference to the interrelationship between stability and controllability. The application potential and experience of PI methods for dynamic wind tunnel testing and requirements necessary for gaining more insight and confidence in using static and dynamic wind tunnel data for flight/ground testing corelation are discussed. E.A.K.

N81-31116*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ESTIMATION OF DYNAMIC STABILITY PARAMETERS FROM DROP MODEL FLIGHT TESTS

Joseph R. Chambers and Kenneth W. Iliff (NASA. Hugh L. Dryden Flight Research Center) *In* AGARD Dyn. Stability Parameters May 1981 13 p refs

Avail: NTIS HC A17/MF A01 CSCL 01C

The overall remotely piloted drop model operation, descriptions, instrumentation, launch and recovery operations, piloting concept, and parameter identification methods are discussed. Static and dynamic stability derivatives were obtained for an angle attack range from -20 deg to 53 deg. It is indicated that

the variations of the estimates with angle of attack are consistent for most of the static derivatives, and the effects of configuration modifications to the model were apparent in the static derivative estimates. E.A.K.

N81-31117# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
ANALYTICAL DETERMINATION OF DYNAMIC STABILITY PARAMETERS
C. P. Schneider *In* AGARD Dyn. Stability Parameters May 1981 40 p refs
Avail: NTIS HC A17/MF A01

The design of modern missiles for military use is characterized by compromises between flight stability and high maneuverability is discussed. High maneuverability yet stable flight performance requires secure missile control at high angles of attack and yaw, with possibly rapid changes of these angles and of the roll angle, and with coupled motions. The aerodynamic derivatives needed for performance predictions result from complex solutions of nonlinear and unsteady or quasisteady relations. Derivatives of longitudinal stability are discussed. For subsonic flow conditions, the derivatives of the missile components, are investigated at high angles of attack. The scope of performances of modern missiles includes high angle of attack maneuverability in supersonic flight. A prediction method based on the theory of indicial functions is outlined for slender wings. Possibilities of obtaining the stability derivatives of bodies at high angle of attack in supersonic flight are discussed. The application of solution methods using finite elements or paneling is presented. E.A.K.

N81-31118# Lockheed Missiles and Space Co., Sunnyvale, Calif.
AEROELASTICITY, INCLUDING DYNAMIC EFFECTS OF SEPARATED FLOW
L. E. Ericsson *In* AGARD Dyn. Stability Parameters May 1981 27 p refs
Avail: NTIS HC A17/MF A01

Static experimental data used to define the unsteady aerodynamics of separated flow, and how these are used to define the dynamic structural response are described. The static aeroelastic response and the structural divergence, are determined by using experimental results directly. However, this is not the case regarding the dynamic response of the structure. By using the static experimental data in pseudostatic analysis theory, the aerodynamic damping of an elastic vehicle including the often dominating effects of separated flow can be computed. The method was applied to predict the aeroelastic characteristics of the Saturn-Apollo and space shuttle launch vehicles. E.A.K.

N81-31119# Royal Aircraft Establishment, Farnborough (England).
CONTROL DERIVATIVES
A. Jean Ross *In* AGARD Dyn. Stability Parameters May 1981 11 p refs
Avail: NTIS HC A17/MF A01

Two groups of dynamic parameters associated with control surfaces are discussed. The first group consists of the hinge moments which determine the dynamic response of the control surface to the control demand. The second group consists of the control derivatives which influence the dynamic response of the aircraft. The dynamic stability parameters of the aircraft with control system are dependent on the control characteristics, and examples are given to illustrate both this dependence and the typical variations of control derivatives with angle of attack and Mach number. Selected results for conventional control surfaces (flaps, elevator, aileron and rudder) and for other controls of current interest (horizontal and vertical canards and vectored thrust) are included. E.A.K.

N81-31120# National Aeronautical Establishment, Ottawa (Ontario).
SENSITIVITY OF AIRCRAFT MOTION TO CROSS COUPLING AND ACCELERATION DERIVATIVES
K. J. Orlik-Rueckemann *In* AGARD Dyn. Stability Parameters May 1981 13 p refs

Avail: NTIS HC A17/MF A01

Modern military aircraft are often designed to maneuver at relatively high angles of attack and therefore are subjected to conditions where the flow becomes highly asymmetric. They are sometimes equipped with direct lift or direct sideforce controls and therefore able to perform translational as well as the traditional rotational maneuvers. Under such flight conditions and maneuvers, certain derivatives that are negligible under symmetric, low angle of attack flight conditions may become large enough to be significant. These include certain static and dynamic cross coupling derivatives and derivatives due to translational acceleration. Most derivatives usually display strong nonlinearities at high angles of attack. E.A.K.

N81-31121*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SOME APPLICATIONS OF AERODYNAMIC FORMULATIONS TO PROBLEMS IN AIRCRAFT DYNAMICS
Lewis B. Schiff and Murray Tobak *In* AGARD Dyn. Stability Parameters May 1981 15 p refs

Avail: NTIS HC A17/MF A01 CSCL 01C

Two applications of mathematical modeling to aerodynamic problems are cussed. The first application is an investigation of the capacity of a nonlinear aerodynamic mathematical model to describe the aerodynamic reactions on an airfoil with a deflecting flap in transonic flow. Flow field computational methods are used to evaluate the nonlinear, unsteady aerodynamic data in terms of characteristic motions called for by the model. Histories of unconstrained motions of the flap are generated from the flap equations of motion, with the aerodynamic reactions specified by the mathematical model. In the second application wing rock is investigated. The most recent model accommodates experimental results wing rock by admitting the existence of aerodynamic hysteresis in the variation of the steady state rolling moment coefficient with roll angle is described. E.A.K.

N81-31122*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
APPLICATIONS OF DYNAMIC STABILITY PARAMETERS TO PROBLEMS IN AIRCRAFT DYNAMICS
Joseph R. Chambers, Daniel J. DiCarlo, and Joseph L. Johnson, Jr. *In* AGARD Dyn. Stability Parameters May 1981 12 p refs
Avail: NTIS HC A17/MF A01 CSCL 01C

The application and analysis of dynamic stability parameters were examined. The effects of wing leading edge modifications on the stalling and spinning characteristics of a single engine general aviation research airplane are evaluated. It is illustrated how dynamic stability parameters measured in wind tunnel tests are used to predict the spin resistance of this class of aircraft, and that autorotation criteria are derived from the relationships which exist between static and dynamic aerodynamic characteristics. E.A.K.

N81-31141*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WALL INTERFERENCE EFFECTS: STATUS REVIEW
P. A. Newman and W. B. Kemp, Jr. *In its* High Reynolds Number Res. - 1980 Sep. 1981 p 123-241 refs

Avail: NTIS HC A14/MF A01 CSCL 01A

The interference technology incorporated into the NTF design (hardware) and the emerging transonic wall interference assessment correction procedures (software) to be employed when the NTF becomes operational was reviewed. It is anticipated that the early experiments will provide data relevant to wall interference effects. E.A.K

N81-31142*# Boeing Commercial Airplane Co., Seattle, Wash.
COMMENTS ON REYNOLDS NUMBER EFFECTS AND THE ROLE OF NTF IN THE DEVELOPMENT OF AIR VEHICLES
A. L. Nagel *In* NASA. Langley Research Center High Reynolds Number Res. - 1980 Sep. 1981 p 143-148 ref

Avail: NTIS HC A14/MF A01 CSCL 01A

The National Transonic Facility (NTF) capability to match the full scale Reynolds numbers of all but the largest airplanes is discussed. Conversion factors to enable calculation of SI-unit equivalents for all U.S. units are listed. Using data from several facilities, analytic methods, and flight test data, a competitive aircraft in the relatively low Reynolds number was developed. The NTF offers the capability to obtain data at full scale Reynolds numbers in the cruise condition for most of the products, and will be much closer than previous tunnels to full scale Reynolds number for the operating envelopes. It is primarily on the operating envelope that Reynolds number effects are most important and least predictable. E.A.K.

N81-31143*# Rockwell International Corp., Los Angeles, Calif.
AIRCRAFT DESIGN USING THE NATIONAL TRANSONIC FACILITY
E. Bonner *In* NASA. Langley Research Center High Reynolds Number Res. - 1980 Sep. 1981 p 149-152 refs

Avail: NTIS HC A14/MF A01 CSCL 01C

The utility of the cryogenic high Reynolds number test facility as a production tunnel is evaluated. Aerodynamic performance evaluation, numerical wing design verification, and high Reynolds number theoretical extensions are considered. A priority ranking of NTF uses from an airframe development viewpoint is presented. J.D.H.

N81-31144*# Rockwell International Corp., Los Angeles, Calif.
PROPOSED AEROELASTIC AND FLUTTER TESTS FOR THE NATIONAL TRANSONIC FACILITY
J. R. Stevenson *In* NASA. Langley Research Center High Reynolds Number Res. - 1980 Sep. 1981 p 153-161

Avail: NTIS HC A02/MF A01 CSCL 01A

Tests that can exploit the capability of the NTF and the transonic cryogenic tunnel, or lead to improvements that could enhance testing in the NTF are discussed. Shock induced oscillation, supersonic single degree control surface flutter, and transonic flutter speed as a function of the Reynolds number are considered. Honeycombs versus screens to smooth the tunnel flow and a rapid tunnel dynamic pressure reducer are recommended to improve tunnel performance. J.D.H.

N81-31145*# Douglas Aircraft Co., Inc., Long Beach, Calif. Wind Tunnel Test and Development.
PRELIMINARY USER PLANNING FOR THE NASA NATIONAL TRANSONIC FACILITY
J. D. Cadwell *In* NASA. Langley Research Center High Reynolds Number Res. - 1980 Sep. 1981 p 163-167

Avail: NTIS HC A14/MF A01 CSCL 14B

Anticipated uses for correlation testing, research and development testing, and configuration development are described. The investigation of high and low speed aerodynamics and the types of data desired from tunnel tests are discussed. J.D.H.

N81-31146*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REPORT OF THE PANEL ON FLUID DYNAMICS
Percy J. Bobbitt *In its* High Reynolds Number Res. - 1980 Sep. 1981 p 169-195 refs

Avail: NTIS HC A14/MF A01 CSCL 20D

Areas of investigation in fluid dynamics, recommended experiments, and use of the facility for theory evaluation are discussed. Tunnel flow quality and calibration of the NTF are considered. Recent technological advances affecting tunnel design are surveyed. J.D.H

N81-31147*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va.
HIGH LIFT TECHNOLOGY
Paul L. Coe, Jr. and Richard J. Margason *In its* High Reynolds Number Res. - 1980 Sep. 1981 p 197-213 refs

Avail: NTIS HC A14/MF A01 CSCL 01A

The NASA Langley high lift technology program is reviewed and elements of the program which are considered Reynolds number sensitive are discussed. The Energy Efficient Transport (EET) and Supersonic Cruise Research (SCR) models proposed for high lift studies in the National Transonic Facility (NTF) are described. Recommendations regarding the NTF facility and test techniques are presented. Author

N81-31148*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CONFIGURATION AERODYNAMICS
Edward C. Polhamus and Blair B. Gloss *In its* High Reynolds Number Res. - 1980 Sep. 1981 p 217-234 refs

Avail: NTIS HC A14/MF A01 CSCL 01A

Static aerodynamic research related to aircraft configurations in their cruise or combat modes is discussed. Subsonic transport aircraft, transonic tactical aircraft, and slender wing aircraft are considered. The status and plans of Langley's NTF configuration research program are reviewed. Recommendations for near term configuration research are made. J.D.H.

N81-31149*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REPORT OF THE PANEL ON AEROELASTICITY AND UNSTEADY AERODYNAMICS
Perry W. Hanson *In its* High Reynolds Number Res. - 1980 Sep. 1981 p 237-246 refs

Avail: NTIS HC A14/MF A01 CSCL 01A

The status of recommended areas of study for the NTF are reviewed. Transonic and control surface unsteady aerodynamics, and buffet onset and loads are considered. Testing of dynamically scaled flutter models is discussed. J.D.H.

N81-31150*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REPORT OF THE WIND TUNNEL/FLIGHT CORRELATION PANEL
Theodore G. Ayers *In* NASA. Langley Research Center High Reynolds Number Res. - 1980 Sep. 1981 p 249-262 ref (For primary document see N81-31130 22-02)

Basic calibration of the tunnel prior to conducting any tests, the areas requiring wind tunnel/flight test correlation for validating the NTF, and recommendations for achieving validation of the NTF are discussed. J.D.H.

N81-31151*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
HIGH REYNOLDS NUMBER RESEARCH REQUIREMENTS FOR SPACE VEHICLE DESIGN
Delma C. Freeman, Jr. *In its* High Reynolds Number Res. 1980 Sep. 1981 p 265-274

Avail: NTIS HC A14/MF A01 CSCL 01A

Requirements of entry vehicle design requiring high Reynolds number wind tunnel testing are discussed. The space shuttle orbiter, development of future space transportation systems, and planetary entry data analysis are considered. J.D.H.

N81-31152*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REPORT OF THE PANEL ON THEORETICAL AERODYNAMICS
Jerry C. South, Jr. and Frank C. Thames *In its* High Reynolds Number Res. - 1980 Sep. 1981 p 277-286 refs

Avail: NTIS HC A14/MF A01 CSCL 01A

Interactions between theoretical aerodynamics and the NTF are discussed. The development and validation of computational fluid dynamics computer codes, the determination of Reynolds number scaling laws, and extension of the data bases of entrainment type turbulence models to include high Reynolds number data are recommended areas of study. The major benefit theoretical aerodynamics could have on the NTF is in the quantitative description of wind tunnel wall interference effects. J.D.H.

N81-31153# McDonnell-Douglas Research Labs., St. Louis, Mo.
THREE-DIMENSIONAL TRANSONIC FLOW ANALYSIS Final Scientific Report, 1 May 1976 - 30 Jun. 1980
Gerald E. Chmielewski and Frank W. Spaid 30 Jun. 1980 97 p refs
(Contract F44620-76-C-0096; AF Proj. 2307)
(AD-A101944; MDC-Q0722; AFOSR-81-0572TR) Avail: NTIS HC A05/MF A01 CSCL 20/4

A computer program was written to calculate the steady, inviscid, transonic flow about an unyawed wing/body configuration. The code is based on the nonconservative form of the full potential equation formulated in global, wing-adapted coordinates that are not surface-conforming. Numerical solution of the governing equations is accomplished via application of type-dependent, rotated finite-difference operators and the method of line relaxation. Exact wing/body surface conditions are enforced by an imaging scheme that involves both surface control points and surface-adjacent computation points. Coordinate stretching permits far-field boundary conditions to be treated exactly; an embedded relaxation scheme computes the downwash field in

the Trefftz plane. Present geometric capability includes a quite general wing attached at mid-height to a blunt-nosed, semi-infinite cylinder of varying crossplane radius. Representative solutions computed on a grid of moderate density are presented for a checkout configuration that includes ONERA Wing M6; comparisons with wing-alone experimental data are shown also. Code limitations and modifications required to further develop the program are discussed. A code listing and a user's guide summary are provided. Author (GRA)

N81-31154# Nielsen Engineering and Research, Inc., Mountain View, Calif.

BASIC STUDIES OF BODY VORTICES AT HIGH ANGLES OF ATTACK AND SUPERSONIC SPEEDS Final Report, 1 Jun. 1979 - 31 May 1980

Goetz H. Klopfer and Jack N. Nielsen Oct. 1980 88 p refs (Contract N00014-78-C-0490; RR0141104)

(AD-A102241; NEAR-TR-226) Avail: NTIS HC A05/MF A01 CSCL 20/4

The problem of computing the steady inviscid supersonic flows about tangent ogive cylinders at high angles of attack with symmetric body vortices is solved in this report. To obtain an efficient procedure the steady Euler equations are used as the basic governing equations as opposed to the more complicated Navier-Stokes equation. the viscous effects, important near the separation line, are simulated by a Kutta condition. The rest of the flow field is essentially controlled by the inviscid equations. The equations, written in conservation form in generalized curvilinear coordinates, are approximated by MacCormack's second-order accurate predictor-corrector algorithm. The flow tangency conditions at the body surface are satisfied by Abbett's scheme and the outer bow-shock position by the Rankine-Hugoniot jump relations. Internal shock waves or tangentially discontinuities are captured. GRA

N81-31157# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

EVALUATION OF TING'S METHOD FOR THE CALCULATION OF THE LIFT DISTRIBUTION ON A WING IN PROPULSIVE JETS

R. A. Maarsingh Nov. 1979 71 p refs (Contract NIVR-1768)

(NLR-TR-80078-U) Avail: NTIS HC A04/MF A01

An adaptation of Ting's method was compared with wind tunnel test data. The nonlinear wing-in-jet problem was made tractable by treating the more complicated flow phenomena (nonuniformity and large disturbances) under the assumption of two dimensional flow, while the remaining, three dimensional effects are reduced to a relatively simple correction to the flow direction in planes perpendicular to the span. The half model wing had a rectangular planform, an 11% thick Clark Y profile and an aspect ratio of eight. Identical model nacelles generated two propulsive jets of 0.2 m dia. with uniform parallel velocity. Some data were taken with the wing outside a single jet. Very satisfactory results were found for the unflapped wing lying centrally within the jets. Both flap deflection and eccentricity cause the prediction of the jet-induced lift change to deteriorate. Discrepancies in applications to wing-outside-jet configurations were found. Author (ESA)

N81-31158# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aeroelastik.

UNSTEADY AIRLOADS ON OSCILLATING WINGS IN POST-STALL CONDITION

Peter Bublitz Apr. 1981 35 p refs

(DFVLR-FB-81-16) Avail: NTIS HC A03/MF A01

Wind tunnel tests were performed on two wing configurations; a basic trapezoidal half-wing model and the same basic wing equipped with a strake. The tests were executed under incompressible flow conditions in a low-speed wind tunnel at a mach number less than 0.2 and a maximum Reynolds number of 2,000,000. The steady mean angles of attack covered the range 0 to 40 deg. The wings could be excited to forced oscillations with angular amplitudes up to 4 deg and in the frequency range 0 to 12 Hz corresponding to a range of reduced frequencies $0 < \text{omega}^* < 0.9$. The steady mean pressures are found to be strongly dependent on the geometry of the wing as well as on the angle of attack. The dependence on the latter is quite nonlinear as a consequence of the complex vortex systems. The unsteady pressure fluctuations due to the flow separation from the stationary wing can be explained rather well by means of the steady mean pressure distributions. At very high incidence the possibility of periodic vortex shedding can be shown. From coherence functions it becomes evident that the correlation lengths in the chordwise direction are considerable. Author (ESA)

N81-31159*# Virginia Univ., Charlottesville. Dept. of Mechanical and Aerospace Engineering.

MINIMUM NOISE IMPACT AIRCRAFT TRAJECTORIES Final Report

Ira D. Jacobson and R. G. Melton Sep. 1981 206 p refs (Grant NsG-1509)

(NASA-CR-164719; UVA/528166/MAE81/101) Avail: NTIS HC A10/MF A01 CSCL 01C

Numerical optimization is used to compute the optimum flight paths, based upon a parametric form that implicitly includes some of the problem restrictions. The other constraints are formulated as penalties in the cost function. Various aircraft on multiple trajectores (landing and takeoff) can be considered. The modular design employed allows for the substitution of alternate models of the population distribution, aircraft noise, flight paths, and annoyance, or for the addition of other features (e.g., fuel consumption) in the cost function. A reduction in the required amount of searching over local minima was achieved through use of the presence of statistical lateral dispersion in the flight paths. T.M.

N81-31160*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.

PREDICTING THE IMPACTS OF NEW TECHNOLOGY AIRCRAFT ON INTERNATIONAL AIR TRANSPORTATION DEMAND

Raymond A. Ausrotas Hampton, Va. NASA. Langley Research Center Jan. 1981 52 p refs (Contract NAS1-15268)

(NASA-CR-165654; FTL-R80-11) Avail: NTIS HC A04/MF A01 CSCL 01C

International air transportation to and from the United States was analyzed. Long term and short term effects and causes of travel are described. The applicability of econometric methods to forecast passenger travel is discussed. A nomograph is developed which shows the interaction of economic growth, airline yields, and quality of service in producing international traffic. E.A.K.

N81-31162*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION TRANSFER PROBLEMS IN THE AVIATION SYSTEM

Charles E. Billings, ed. and Ed S. Cheaney, ed. Sep. 1981 95 p refs

(NASA-TP-1875; A-8567) Avail: NTIS HC A05/MF A01 CSCL 17B

Problems in the transfer of information within the aviation system are discussed. Particular attention is given to voice communication problems in both intracockpit and air/ground situations.

N81-31163*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DIMENSIONS OF THE INFORMATION TRANSFER PROBLEM

Charles E. Billings and William D. Reynard *In its* Inform. Transfer Probl. in the Aviation System Sep. 1981 p 9-14 refs

Avail: NTIS HC A05/MF A01 CSCL 17B

Several facets of the information transfer problems in aviation are described. A general analysis of these problem are given and the implications of some proposed solutions discussed. It is concluded that information transfer problems are responsible for many potentially serious human errors in aviation operations. R.C.T.

N81-31165*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION TRANSFER IN THE SURFACE COMPONENT OF THE SYSTEM: COORDINATION PROBLEMS IN AIR TRAFFIC CONTROL

Ralph L. Grayson *In its* Inform. Transfer Probl. in the Aviation

System Sep. 1981 p 25-46 refs

Avail: NTIS HC A05/MF A01 CSCL 17B

The significance of coordination in the air traffic control system is discussed. An attempt is made to determine the circumstances that appear to encourage coordination failures as well as examine the human and system factors involved in these failures. Possible means of reducing the rate of such failures are also considered. R.C.T.

N81-31166*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION TRANSFER BETWEEN AIR TRAFFIC CONTROL AND AIRCRAFT: COMMUNICATION PROBLEMS IN FLIGHT OPERATIONS

Ralph L. Grayson and Charles E. Billings *In its* Inform. Transfer Probl. in the Aviation System Sep. 1981 p 47-61 ref

Avail: NTIS HC A05/MF A01 CSCL 17B

Problems in communications between flightcrews and air traffic controllers were investigated as part of an analysis of information transfer problems in the national aviation system. Particular attention was given to problems in oral communication between pilots and controllers. R.C.T.

N81-31167*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION TRANSFER WITHIN THE COCKPIT: PROBLEMS IN INTRACOCKPIT COMMUNICATIONS

H. Clayton Foushee and Karen L. Manos *In its* Inform. Transfer Probl. in the Aviation System Sep. 1981 p 63-71 refs

Avail: NTIS HC A05/MF A01 CSCL 17B

The role of communication patterns among cockpit crew members is discussed. Emphasis is placed on information transfer problems which include: messages that are untimely; messages that are not received or understood; and less common, messages that are not transferred because of equipment failure. R.C.T.

N81-31168*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION TRANSFER DURING CONTINGENCY OPERATIONS: EMERGENCY AIR-GROUND COMMUNICATIONS

Richard F. Porter *In its* Inform. Transfer Probl. in the Aviation System Sep. 1981 p 73-83 ref

Avail: NTIS HC A05/MF A01 CSCL 17B

Safety related problems are reported which occur as a consequence of information transfer deficiencies that arise when air/ground communications are (or should be) used as a resource in inflight emergency situations. The system factors, the human errors, and the associated causes of these problem are defined. R.C.T.

N81-31169*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE INFORMATION TRANSFER PROBLEM SUMMARY AND COMMENTS

Charles E. Billings and Ed S. Cheaney *In its* Inform. Transfer Probl. in the Aviation System Sep. 1981 p 85-94 refs

Avail: NTIS HC A05/MF A01 CSCL 17B

An attempt is made to illuminate the problems associated with deficiencies in the information transfer process of both intracockpit and air/ground communications. Possible steps are suggested as a means of enhancing the flow of information in the aviation system. R.C.T

N81-31171*# BioTechnology, Inc., Falls Church, Va.

A FLIGHT INVESTIGATION OF SIMULATED DATA-LINK COMMUNICATIONS DURING SINGLE-PILOT IFR FLIGHT. VOLUME 1: EXPERIMENTAL DESIGN AND INITIAL TEST Final Report

James F. Parker, Jr., Jack W. Duffy, and Diane G. Christensen Washington NASA Aug. 1981 61 p refs
(Contract NAS1-16037)
(NASA-CR-3461-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 17G

A Flight Data Console simulation of a digital communication link to replace the current voice communication system used in air traffic control (ATC) was developed. The study determined how a digital communications system reduces cockpit workload, improve, flight proficiency, and is acceptable to general aviation pilots. It is shown that instrument flight, including approach and landing, can be accomplished by using a digital data link system for ATC communication. E.A.K.

N81-31180# Radio Technical Commission for Aeronautics, Washington, D. C.

MINIMUM OPERATIONAL PERFORMANCE STANDARDS FOR MICROWAVE LANDING SYSTEM (MLS) AIRBORNE RECEIVING EQUIPMENT

Jul. 1981 112 p refs
(RTCA/DO-177) Avail: NTIS HC A06/MF A01

Incorporated within these standards are system characteristics that will be beneficial to the various users of the system as well as designers, manufacturers and installers. A configuration of airborne receiving equipment is limited to: antenna system, transmission lines, angle guidance receiver, receiver control unit and interface with aircraft displays/systems which, for the near term, deals specifically with the angle-only receiver exclusive of distance measuring equipment (DME). Additional functions and components that refer to expanded capabilities are identified as optional features. T.M.

N81-31181# Federal Aviation Agency, Atlantic City, N.J.

ACTIVE BEACON COLLISION AVOIDANCE LOGIC EVALUATION. VOLUME 1: MODE C EQUIPPED (ATCRBS) THREAT PHASE Final Report

A. Adkins, B. Billmann, J. Thomas, and J. Windle Jun. 1981 92 p refs
(FAA Proj. 052-241-320)
(AD-A102163; FAA-CT-80-51-1; FAA-RD-80-125-1) Avail: NTIS HC A05/MF A01 CSCL 01/2

The purpose of this project was to evaluate and refine the April 1979 version of the Beacon Collision Avoidance System (BCAS) logic prior to Active BCAS prototype flight testing. The April 1979 version of the BCAS logic added changes to support multiple aircraft resolution, conflict indicator register interfacing, and new surveillance function interfacing. The first phase of the evaluation was conducted from April 1979 to September 1979. This phase evaluated logic performance against mode C equipped (ATCRBS) threats. The evaluation identified modifications which could improve logic performance. Interim improvements have been made to the vertical tracker. The modifications improve command sense choice logic performance for ATCRBS threats (by using greater dependence on current relative vertical position), resolution performance (by modifying ATCRBS-threat sense choice logic), and vertical speed limit (VSL) alarm performance. Generally, good protection was provided by the BCAS logic against abrupt horizontal maneuvers by ATCRBS threats. VSL alarms generated sufficient vertical separation when the BCAS aircraft's vertical rate was above 1,000 feet per minute. Below 1,000 feet per minute, tracker noise often resulted in a transition from VSL alarms to positive or negative BCAS maneuver advisories. Before proceeding to subsequent phases of the evaluation, large portions of the logic modifications that were identified in this report became permanent algorithm changes. Author (GRA)

N81-31182# Federal Aviation Administration, Washington, D.C. Office of Aviation Policy and Plans.

NAS AUTOMATION EQUIPMENT OPERATING COST ESTIMATES, FY 1978 - 1979

Jerry Collins Jun. 1981 92 p refs
(AD-A102023; FAA-APO-81-6) Avail: NTIS HC A05/MF A01 CSCL 05/1

This report provides summary information related to the cost of maintenance and support of certain system elements of the National Airspace System. Specific equipments for which support costs were developed include the major automation equipments of the enroute and the terminal air traffic control systems. The reader is reminded that this study effort was initiated prior to the formal establishment of the Computer Replacement Program and that the equipment under consideration for replacement is only partially matched by the list of equipment addressed in the study. The information developed should prove useful, however, in evaluating equipment common to both sets. The equipments which are the basis for this report cost about $137 million in support and maintenance during FY 1979. Of this total, about $112 million (82%) was labor, $9 million (6%) was material and $16 million (12%) was services. Of the total $112,218,000 of

FAA labor AIRWAY FACILITIES cost $78,947,000 (70%), AIR TRAFFIC software support was $30,027,000 (27%) and other labor was $3,244,000 (3%). Support of the Enroute equipments cost $79,647,000 (58%) and Terminal equipments cost $57,339,000 (42%). Author (GRA)

N81-31183# Quinby (Gilbert F.), Fort Washington, Pa.
PROCEEDINGS OF THE PUBLIC WORKSHOP ON ALTERNATIVE SEPARATION CONCEPTS: PRESENTATIONS, DISCUSSIONS AND RECOMMENDATIONS Final Report
Jun. 1981 208 p Workshop held at Atlantic City, 7-9 Jan. 1981
(Contract DTFA03-80-C-00082)
(AD-A102519; FAA-EM-81-7) Avail: NTIS HC A10/MF A01 CSCL 17/7

This report documents the proceedings of a Federal Aviation Administration (FAA) public workshop on Alternative Separation Concepts during January 7-9, 1981. The first day was devoted to presentations describing FAA/NASA ongoing programs to improve the ATC system with an emphasis on those aspects which would directly improve the services offered to pilots. These improvements would primarily ease the entry into and exit from the IFR system, and the accommodation of pilot preferred routings. The second and part of the third day were devoted to participant discussions which are unrecorded. There were three working groups, technical, procedural and economic which reported their recommendations at the close of the workshop. The participants at the workshop did not identify a fundamentally new concept for air traffic control. They concluded that it would be desirable to continue development of existing and planned Secondary Surveillance Radar-based systems. The promising approaches to system improvements to permit a greater degree of freedom of GA operations were classified by the availability of surveillance services. Within ground-based surveillance coverage, and automatic ground-based primary separation service was the recommended approach. Outside of surveillance coverage, an airborne-based primary separation service utilizing the signal format of the improved secondary surveillance radar system was recommended for further development.
Author (GRA)

N81-31184*# Kentron International, Inc., Hampton, Va.
DESIGN AND ANALYSIS OF A FUEL-EFFICIENT SINGLE-ENGINE, TURBOPROP-POWERED, BUSINESS AIRPLANE
G. L. Martin, D. E. Everest, Jr., W. A. Lovell, J. E. Price, K. B. Walkley, and G. F. Washburn Hampton, Va. NASA. Langley Research Center Aug. 1981 37 p refs
(Contract NAS1-16000)
(NASA-CR-165768) Avail: NTIS HC A03/MF A01 CSCL 01C

The speed, range, payload, and fuel efficiency of a general aviation airplane powered by one turboprop engine was determined and compared to a twin engine turboprop aircraft. An airplane configuration was developed which can carry six people for a noreserve range of 2,408 km at a cruise speed above 154 m/s, and a cruise altitude of about 9,144 m. The cruise speed is comparable to that of the fastest of the current twin turboprop powered airplanes. It is found that the airplane has a cruise specific range greater than all twin turboprop engine airplanes flying in its speed range and most twin piston engine airplanes flying at considerably slower cruise airspeeds. E.A.K.

N81-31185*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
VEHICLE CONCEPTS AND TECHNOLOGY REQUIREMENTS FOR BUOYANT HEAVY-LIFT SYSTEMS
Mark D. Ardema Sep. 1981 18 p refs
(NASA-TP-1921; A-8022) Avail: NTIS HC A02/MF A01 CSCL 01C

Several buoyant-vehicle (airship) concepts proposed for short hauls of heavy payloads are described. Numerous studies identified operating cost and payload capacity advantages relative to existing or proposed heavy-lift helicopters for such vehicles. Applications involving payloads of from 15 tons up to 800 tons were identified. The buoyant quad-rotor concept is discussed in detail, including the history of its development, current estimates of performance and economics, currently perceived technology requirements, and recent research and technology development. It is concluded that the buoyant quad-rotor, and possibly other buoyant vehicle concepts, has the potential of satisfying the market for very heavy vertical lift but that additional research and technology development are necessary. Because of uncertainties in analytical prediction methods and small-scale experimental measurements, there is a strong need for large or full-scale experiments in ground test facilities and, ultimately, with a flight research vehicle. Author

N81-31186# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
FACTORS OF SAFETY RELATED TO STRUCTURAL INTEGRITY. A REVIEW OF DATA FROM MILITARY AIRWORTHINESS AUTHORITIES
Jun. 1981 44 p
(AGARD-R-677; ISBN-92-835-1390-8) Avail: NTIS HC A03/MF A01

The numerical factors applied to insure structural safety of aircraft are presented. Documents and specifications where the factors of safety are defined are identified. The relation of design conditions to extreme operational conditions is considered. Relevant aerodynamic effects taken into account in addition to the safety factors are discussed. The application of the safety factors to rare events, loading, and to experimental aircraft is discussed. Varying interpretations of the factors of safety are considered, and differences between the NATO countries with regard to structural safety are discussed. J.D.H.

N81-31187# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
STATISTICAL REVIEW OF COUNTING ACCELEROMETER DATA FOR NAVY AND MARINE FLEET AIRCRAFT FROM 1 JANUARY 1962 TO 31 DECEMBER 1980 Semiannual Summary Report, 1 Jan. - 31 Dec. 1980
Warren J. Williams 1 May 1981 156 p Supersedes NADC-13920-2 Prepared for Naval Air Systems Command, Washington, D.C.
(AD-A102495; NADC-13920-2) Avail: NTIS HC A08/MF A01 CSCL 01/1

This is a semi-annual progress report, and it presents a specialized summary of the data in the counting accelerometer program. Statistics describing Navy and Marine aircraft cumulative g-count exceedances are calculated and tabulated. These tabulations are separated by calendar time and into four major categories of fleet experience: Navy Training, Navy Combat, Marine Training, and Marine Combat. These data show that the load rate distributions (counts at 1000 hours) for most models and most g-levels have a non-normal distribution. Within a model (A-7E, F-4N, etc.) differences in the average load rates exist when data are separated by calender time or mission category.
Author (GRA)

N81-31188# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
TRANSITION AND CONVERSION TRIM-MAPS FOR THE AV-8A VTOL AIRCRAFT Final Report
Bruce Hildreth Aug. 1980 148 p refs
(Contract N00014-78-C-0381; NR Proj. 215-262)
(AD-A102155; MAE-1466; ONR-CR-215-262-1F) Avail: NTIS HC A07/MF A01 CSCL 01/2

A mathematical computer model, 'HARRIER' of the AV-8A Harrier aircraft has been developed utilizing the concept of quasi-stationary flight in order to determine quasi-equilibrium values of flight variables and controls during accelerating-decelerating flight. Using available aerodynamic data via look-up schemes, 'trim-maps' are computed which show the values of the longitudinal flight and control variables as functions of airspeed and thrust angle. These maps have been shown to be useful tools in piecing together transition profiles, taking in consideration various requirements and constraints. The final decelerating-descending phase of the present USMC approach profile has been analyzed in detail with the aid of the trim-maps. The technique of flying the transition as suggested by the trim-maps has been found in good agreement with the techniques actually used under the given constraints. This established confidence in both the mathematical model and in the trim-maps as tools for studying alternate transition profiles. Author (GRA)

N81-31189# National Aerospace Lab., Amsterdam (Netherlands).
DAMAGE TOLERANCE OF A LANDING GEAR COMPONENT AFTER MANY TAKEOFFS AND LANDINGS
E. A. B. Degraaf, P. deRijk, and G. F. J. A. vanGestel 10 Oct. 1979 17 p refs In DUTCH; ENGLISH summary Presented at Ann. Conf. of German Soc. for Nondestructive Testing,

Goettingen, West Germany, 12-14 May 1980
(NLR-MP-79039-U) Avail: NTIS HC A02/MF A01

A test procedure was applied to establish the damage tolerance of a landing gear component showing fatigue cracking. During an inspection almost all specimens of the particular low alloy high strength steel component showed cracks after many starts and landings. Continued safe operation was shown to be possible by means of a systematic establishment of the residual strength of the most heavily cracked components, simultaneously with an evaluation of the accuracy of several nondestructive inspection methods: fluorescent magnetic powder method, fluorescent paint penetration and eddy currents. The correspondence between defect indication and actual fatigue nucleus sizes, as measured from the fracture surface, is clearly demonstrated. On the basis of the tests the components were shown to be damage tolerant and a nondestructive inspection procedure for subsequent components established. Author (ESA)

N81-31190*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FIBER OPTICS FOR AIRCRAFT ENGINE/INLET CONTROL

Robert J. Baumbick 1981 13 p refs Presented at the Intern. Symp. and Instrument Display, San Diego, Calif., 24-28 Aug. 1981; sponsored by the Society of Photo-Optical Instrumentation Engineers
(NASA-TM-82654; E-917) Avail: NTIS HC A02/MF A01 CSCL 01D

NASA programs that focus on the use of fiber optics for aircraft engine/inlet control are reviewed. Fiber optics for aircraft control is attractive because of its inherent immunity to EMI and RFI noise. Optical signals can be safely transmitted through areas that contain flammable or explosive materials. The use of optics also makes remote sensing feasible by eliminating the need for electrical wires to be connected between sensors and computers. Using low-level optical signals to control actuators is also feasible when power is generated at the actuator. Each application of fiber optics for aircraft control has different requirements for both the optical cables and the optical connectors. Sensors that measure position and speed by using slotted plates can use lossy cables and bundle connectors if data transfer is in the parallel mode. If position and speed signals are multiplexed, cable and connector requirements change. Other sensors that depend on changes in transmission through materials require dependable characteristics of both the optical cables and the optical connectors. A variety of sensor types are reviewed, including rotary position encoders, tachometers, temperature sensors, and blade tip clearance sensors for compressors and turbines. Research on a gallium arsenide photoswitch for optically switched actuators that operate at 250 C is also described.
Author

N81-31191# Naval Air Development Center, Warminster, Pa. Software and Computer Directorate.

HIGH SPEED MULTIPLEX BUS PROTOCOL STUDY

James S. Verdi 15 Jun. 1980 92 p refs Prepared for Naval Air Systems Command, Washington, D.C.
(WF21200000; WF212421091)
(AD-A102113; NADC-81049-50) Avail: NTIS HC A05/MF A01 CSCL 17/2

This report presents the current results of an evaluation performed in support of the development of an advanced high speed digital avionics data bus. Emphasis is placed on certain areas of protocol design and implementation which have not been approaches very aggressively in other development efforts. These areas include a transaction oriented protocol design and greatly increased level of protocol definition stressing VLSI (and perhaps VHSIC) implementation. A detailed but preliminary protocol design is included to illustrate the concepts presented.
Author (GRA)

N81-31193*# TRW, Inc., Cleveland, Ohio.

AUTOMATED PLASMA SPRAY (APS) PROCESS FEASIBILITY STUDY Final Contractor Report, Jun. 1976 - Mar. 1981

C. W. Fetheroff, T. Derkacs, and I. M. Matay Mar. 1981 131 p refs
(Contract NAS3-20112)
(NASA-CR-165418; TRW-ER-8019-F) Avail: NTIS HC A07/MF A01 CSCL 21E

An automated plasma spray (APS) process was developed to apply two layer (NiCrAlY and ZrO2-12Y2O3) thermal barrier coatings to aircraft and stationary gas turbine engine blade airfoils. The APS process hardware consists of four subsystems: a mechanical positioning subsystem incorporating two interlaced six degree of freedom assemblies (one for coating deposition and one for coating thickness monitoring); a noncoherent optical metrology subsystem (for in process gaging of the coating thickness buildup at specified points on the specimen); a microprocessor based adaptive system controller (to achieve the desired overall thickness profile on the specimen); and commerical plasma spray equipment. Over fifty JT9D first stage aircraft turbine blade specimens, ten W501B utility turbine blade specimens and dozens of cylindrical specimens were coated with the APS process in preliminary checkout and evaluation studies. The best of the preliminary turbine blade specimens achieved an overall coating thickness uniformity of 53 micrometers (2.1 mils), much better than is achievable manually. Comparative evaluations of coating thickness uniformity for manually sprayed and APS coated specimens were performed. One of the preliminary turbine blade evaluation specimens was subjected to a torch test and metallograhic evaluation. Some cylindrical specimens coated with the APS process survived up to 2000 cycles in subsequent burner rig testing. Author

N81-31194*# General Electric Co., Cincinnati, Ohio. Technology Programs and Performance Technology Dept.

STRUCTURES PERFORMANCE, BENEFIT, COST-STUDY Final Report

Otto G. Woike, C. Salemme, E. Stearns, P. Oritz, M. L. Roberts, J. L. Baughman, R. P. Johnston, H. F. Demel, R. G. Stabrylla, and G. A. Coffinberry Sep. 1981 195 p refs
(Contract NAS3-22049)
(NASA-CR-165456; R81AEG393) Avail: NTIS HC A09/MF A01 CSCL 21E

New technology concepts and structural analysis development needs which could lead to improved life cycle cost for future high-bypass turbofans were studied. The NASA-GE energy efficient engine tecnnology is used as a base to assess the concept benefits. Recommended programs are identified for attaining these generic structural and other beneficial technologies. T.M.

N81-31195*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ADVANCED SUBSONIC TRANSPORT PROPULSION

Donald L. Nored, Carl C. Ciepluch, Roger Chamberlain, Edward T. Meleason, and Gerald A. Kraft 1981 32 p refs Presented at the Intern. Air Transportation Conf., Atlantic City, N.J. 26-28 May 1981; sponsored by AIAA and SAE
(NASA-TM-82696; E-979) Avail: NTIS HC A03/MF A01 CSCL 21E

A brief review of the current NASA Energy Efficient Engine (E(3)) Project is presented. Included in this review are the factors that influenced the design of these turbofan engines and the advanced technology incorporated in them to reduce fuel consumption and improve environmental characteristics. In addition, factors such as the continuing spiral in fuel cost, that could influence future aircraft propulsion systems beyond those represented by the E(3) engines, are also discussed. Advanced technologies that will address these influencing factors and provide viable future propulsion systems are described. The potential importance of other propulsion system types, such as geared fans and turboshaft engines, is presented. T.M.

N81-31196*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AIRCRAFT ENGINE DIAGNOSTICS

Jul. 1981 377 p refs Conf. held at Cleveland, 6-7 May 1981
(NASA-CP-2190; E-845) Avail: NTIS HC A17/MF A01 CSCL 21E

Engine durability and performance retention concepts are discussed. Other topics include engine diagnostics for performance retention and engine condition monitoring systems.

N81-31197*# General Electric Co., Schenectady, N. Y.

CF 6 ENGINE DIAGNOSTICS

Ron Stricklin *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 1-17 refs

Avail: NTIS HC A17/MF A01 CSCL 21E

A summary of the activities which led to defining deterioration rates of the CF6 family of engines, a description of what was

learned, and an identification of means of conserving fuel based upon the program findings are presented. The program to define the deterioration levels and modes for the CF6 family of engines involved four distinct phases: analysis of inbound engine test results, analysis of airline cruise data, analysis of airline test cell data resulting from testing of refurbished engines, and inspection of engine hardware. E.D.K

N81-31198*# General Electric Co., Schenectady, N. Y.
CF6 HIGH PRESSURE COMPRESSOR AND TURBINE CLEARANCE EVALUATIONS
M. A. Radomski and L. D. Cline *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 19-42 refs

Avail: NTIS HC A17/MF A01 CSCL 21E

In the CF6 Jet Engine Diagnostics Program the causes of performance degradation were determined for each component of revenue service engines. It was found that a significant contribution to performance degradation was caused by increased airfoil tip radial clearances in the high pressure compressor and turbine areas. Since the influence of these clearances on engine performance and fuel consumption is significant, it is important to accurately establish these relatonships. It is equally important to understand the causes of clearance deterioration so that they can be reduced or eliminated. The results of factory engine tests run to enhance the understanding of the high pressure compressor and turbine clearance effects on performance are described. The causes of clearance deterioration are indicated and potential improvements in clearance control are discussed. E.D.K.

N81-31199*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
JT9D JET ENGINE DIAGNOSTICS PROGRAM
W. J. Olsson and W. J. Stromberg *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 43-61 refs

(Contract NAS3-20632)
Avail: NTIS HC A17/MF A01 CSCL 21E

Performance deterioration in the JT9D-7 is a flight sensitive phenomenon caused by one short term and two long term wear modes. The short term deterioration occurs primarily during airplane acceptance testing and therefore does not affect airline operation. The long term wear takes place continuously over the engine life so that the performance loss can be minimized by a sound maintenance program. Short term deterioration is primarily due to flight load induced blade and gas path seal wear which result in increased gas path running clearances. The wear occurs in all engine modules but has the most deleterious effect on the low pressure compressor and high pressure turbine performance. The wear occurs during conditions that combine minimum axisymmetric running clearances and maximum engine distortion or asymmetric closure. E.D.K.

N81-31200*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
JT8D ENGINE PERFORMANCE RETENTION
Albert D. James and David R. Weisel *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 63-81 ref

Avail: NTIS HC A17/MF A01 CSCL 21E

The attractive performance retention characteristics of the JT8D engine are described. Because of its moderate bypass ratio and turbine temperature, and stiff structural design, the performance retention versus flight cycles of the JT8D engine sets a standard that is difficult for other engines to equal. In addition, the significant benefits of refurbishment of the JT8D engine are presented. Cold section refurbishment offers thrust specific fuel consumption improvements of up to 2 percent and payback in less than a year, making a very attractive investment option for the airlines. E.D.K.

N81-31201*# Rolls-Royce Ltd., London (England).
PERFORMANCE RETENTION OF THE RB211 POWERPLANT IN SERVICE
B. L. Astridge and J. T. Pinder *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 83-102

Avail: NTIS HC A17/MF A01 CSCL 21E

An understanding of the mechanisms of deterioration is essential in order that features to counteract performance degradation can be built into the basic design of an engine and nacelle. Furthermore, the interpretation must be continued in service for effective feedback to provide modifications which may be necessary in maintaining a satisfactory performance retention program. The in service assessment must be accurate as to magnitude and causes and this requires consideration of: (1) the powerplant as a complete entity, i.e., the engine components and nacelle including the thrust reverser; (2) measurement of performance in flight rather than by sole reliance on the scaling of test cell data to flight conditions (although some correlation should be possible); and (3) the relationship of engine parts condition to overhaul performance and in flight deterioration level of that engine. These aspects are addressed by consideration of the RB211 engine in service in both the Lockheed L1011 Tristar and Boeing 747 aircraft. E.D.K.

N81-31202*# Pan American World Airways, Inc., Jamaica, N.Y.
PERFORMANCE DETERIORATION: AN AIRLINE PERSPECTIVE
Niels B. Andersen *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 103-108

Avail: NTIS HC A17/MF A01 CSCL 21E

Certain features of engine design and installation are clearly demonstrating important advantages in engine performance retention. Bearing arrangement no doubt has an important role in performance retention. Four bearings seem to be insufficient while six are probably more than are required. A well designed five-bearing system would seem to be an optimum configuration. Bearings with over-hung components such as fans, should be designed to minimize such over-hang to limit associated wobble, which in turn leads to shroud rub, or to allow closer running clearances. Almost any effort to improve stiffness and generally reduce flexing of the engine structure will pay off significantly in performance retention, even at a weight penalty. For this reason cowl load sharing to provide additional rigidity at a low cost in additional weight and complexity is favored. E.D.K.

N81-31203*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
IMPROVING TURBINE ENGINE COMPRESSOR PERFORMANCE RETENTION THROUGH AIRFOIL COATINGS
L. A. Friedrich *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 109-117 refs

Avail: NTIS HC A17/MF A01 CSCL 21E

In order to evaluate the potential effectiveness of coatings in limiting erosive damage to compressor airfoils, an effort was initiated to evaluate candidate coatings for substrate alloys typically used in commercial engine high compressor blades. Laboratory and rig erosion testing of plasma deposited and diffusion coatings described in this paper have shown the potential of a two to four fold improvement in erosion life. The selective application of these coatings to approximately the outer third of the airfoil avoids coating the fatigue critical region of the blade, thus providing erosion resistance potentially without compromising the fatigue strength of the blade. Both the plasma and the diffusion coatings also offer the advantage of low initial cost and a multi-source production base. E.D.K.

N81-31204*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
ADVANCED OXIDE DISPERSION STRENGTHENED SHEET ALLOYS FOR IMPROVED COMBUSTOR DURABILITY
R. J. Henricks *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 119-136 refs

(Contract NAS3-20072)
Avail: NTIS HC A17/MF A01 CSCL 21E

Burner design modifications that will take advantage of the improved creep and cyclic oxidation resistance of oxide dispersion strengthened (ODS) alloys while accommodating the reduced fatigue properties of these materials were evaluated based on preliminary analysis and life predictions, on construction and repair feasibility, and on maintenance and direct operating costs. Two designs - the film cooled, segmented louver and the transpiration cooled, segmented twin Wall - were selected for low cycle fatigue (LCF) component testing. Detailed thermal and structural analysis of these designs established the strain range and temprature at critical locations resulting in predicted lives of 10,000 cycles for

MA 956 alloy. The ODs alloys, MA 956 and HDA 8077, demonstrated a 167 C (300 F) temperature advantage over Hastelloy X alloy in creep strength and oxidation resistance. The MA 956 alloy was selected for mechanical property and component test evaluations. The MA 956 alloy was superior to Hastelloy X in LCF component testing of the film cooled, segmented louver design. J.M.S.

N81-31206*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN INTRODUCTION TO NASA'S TURBINE ENGINE HOT SECTION TECHNOLOGY (HOST) PROJECT
Daniel J. Gaunther and C. Robert Ensign *In its* Aircraft Engine Diagnostics 1981 p 153-173

Avail: NTIS HC A17/MF A01 CSCL 21E
An overview of research to develop and improve the accuracy of current analysis methods so that increased durability can be designed into future engines is presented. Emphasis is placed on improved accuracy in life prediction. Component design, including description of the thermal and aerodynamic environments, the material's mechanical response, the interactions between environmental and structural response, and high temperature instrumentation capable of measuring near-engine environment effects are addressed. Component tests, improved modeling of the physical phenomena, and tests to verify the proved models are also discussed. J.M.S.

N81-31207*# Boeing Commercial Airplane Co., Seattle, Wash.
THE NATURE OF OPERATING FLIGHT LOADS AND THEIR EFFECT ON PROPULSION SYSTEM STRUCTURES
Kenneth H. Dickenson and Richard L. Martin *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 175-188

Avail: NTIS HC A17/MF A01 CSCL 21E
Past diagnostics studies revealed the primary causes of performance deterioration of high by-pass turbofan engines to be flight loads, erosion, and thermal distortion. The various types of airplane loads that are imposed on the engine throughout the lifetime of an airplane are examined. These include flight loads from gusts and maneuvers and ground loads from takeoff, landing, and taxi conditions. Clarification is made in definitions of the airframer's limit and ultimate design loads and the engine manufacturer's operating design loads. Finally, the influence of these loads on the propulsion system structures is discussed. J.M.S.

N81-31208*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONSERVATION OF STRATEGIC AEROSPACE MATERIALS (COSAM)
Joseph R. Stephens *In its* Aircraft Engine Diagnostics 1981 p 189-207 refs
Avail: NTIS HC A17/MF A01 CSCL 21E
Research efforts to reduce the dependence of the aerospace industry on strategic metals, such as cobalt (Co), columbium (Cb), tantalum (Ta), and chromium (Cr), by providing the materials technology needed to minimize the strategic metal content of critical aerospace components for gas turbine engines are addressed. Thrusts in three technology areas are identified: near term activities in the area of strategic element substitution; intermediate-range activities in the area of materials processing; and long term, high risk activities in the area of 'new classes' of high temprature metallic materials. Specifically, the role of cobalt in nickel-base and cobalt-base superalloys vital to the aerospace industry is examined along with the mechanical and physical properties of intermetallics that will contain a minimum of the stragetic metals. J.M.S.

N81-31209*# Air Force Systems Command, Wright-Patterson AFB, Ohio.
WHO NEEDS ENGINE MONITORING?
James L. Pettigrew *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 209-224 ref

Avail: NTIS HC A17/MF A01 CSCL 21E
Operational evaluations of engine monitoring systems (EMS) are discussed. Options for each required EMS phase are reviewed along with the guidance provided for EMS on new systems. J.M.S.

N81-31210*# Air Force Systems Command, Wright-Patterson AFB, Ohio.
F100 ENGINE DIAGNOSTIC SYSTEM STATUS TO DATE
James A. Boyless *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 225-242

Avail: NTIS HC A17/MF A01 CSCL 21E
An engine diagnostic system, proposed for the F100 engine, was tested in five specially modified Tactical Air Command F-15 aircraft during a 16-month flight evaluation. After more than 3300 engine operating hours encompassing almost 900 flights during the flight evaluation, these aircraft provided a data base, still being analyzed, that has shown successful demonstration of the original functional characteristics. Four general design requirements, recording engine operating time/low cycle fatigue event detection, engine trim, and trend and performance data collection were demonstrated. Also, validation of maintenance actions taken and indicated needed maintenance were successfully demonstrated. J.M.S.

N81-31211*# San Antonio Air Logistics Center, Kelly AFB., Tex.
A-10/TF34 TURBINE ENGINE MONITORING SYSTEM (TEMS)
Robert G. Christopher *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 271-283 refs

Avail: NTIS HC A17/MF A01 CSCL 21E
The hardware and software development of the A-10/TF34 turbine engine monitoring system (TEMS) is described. The operation and interfaces of the A-10/TF34 TEMS hardware are discussed with particular emphasis on function, capabilities, and limitations. The TEMS data types are defined and the various data acquisition modes are explained. Potential data products are also discussed. R.C.T.

N81-31212*# KLM Royal Dutch Airlines, Amsterdam (Netherlands).
REVIEW OF AIDS DEVELOPMENT
Henk C. Vermeulen and Sven G. Danielsson *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 285-310 refs
Avail: NTIS HC A17/MF A01 CSCL 21E
The operation and implementation of the aircraft integrated data system AIDS are described. The system is described as an engineering tool with strong emphasis on analysis of recorded information. The AIDS is primarily directed to the monitoring of parameters related to: the safety of the flight; the performance of the aircraft; the performance of the flight guidance system; and the performance and condition of the engines. The system provide short term trend analysis on a trend chart that is updated by the flight engineer on every flight that lasts more than 4 flight hours. Engine data prints are automatically presented during take-off and in the case of limit excedance, e.g., the print shows an automatically reported impending hotstarts on engine nr. 1. Other significant features are reported. R.C.T.

N81-31213*# Textron Bell Helicopter, Fort Worth, Tex.
HELICOPTER PROPULSION SYSTEM RELIABILITY AND ENGINE MONITORING ASSESSMENTS
John A. Murphy *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 311-322 refs

(Contract NAS2-10722)
Avail: NTIS HC A17/MF A01 CSCL 21E
The major short life, unreliable, and high maintenance engine and power components and subsystems in current civil helicopters were identified. Categories included both reciprocating and turbine engines, single and multiple engine configurations, single and tandem trotor vehicles, and light, medium, and heavy helicopters. The major focus was on the following parameters: accident rate data; maintenance rate data; and direct operator input. R.C.T.

N81-31214*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
ENGINE HEALTH MONITORING SYSTEMS: TOOLS FOR IMPROVED MAINTENANCE MANAGEMENT IN THE 1980'S
Jonathan C. Kimball *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 323-340 refs

see N81-31196 22-07)
Avail: NTIS HC A17/MF A01 CSCL 21E

The performance monitoring aspect of maintenance, characteristic of the engine health monitoring system are discussed. An overview of the system activities is presented and a summary of programs for improved monitoring in the 1980's are discussed. R.C.T.

N81-31215*# General Electric Co., Schenectady, N. Y.
ENGINE CONDITION MONITORING: CF6 FAMILY 60'S THROUGH THE 80'S
H. J. Kent and Gerwin Dienger (Lufthansa German Airlines) *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 341-356
Avail: NTIS HC A17/MF A01 CSCL 21E

The on condition program is described in terms of its effectiveness as a maintenance tool both at the line station as well as at home base by the early detection of engine faults, erroneous instrumentation signals and by verification of engine health. The system encompasses all known methods from manual procedures to the fully automated airborne integrated data system. R.C.T.

N81-31217*# Textron Bell Helicopter, Fort Worth, Tex.
AN OVERVIEW OF SAE ARP 1587: AIRCRAFT GAS TURBINE ENGINE MONITORING SYSTEM GUIDE
John A. Murphy *In* NASA. Lewis Res. Center Aircraft Engine Diagnostics 1981 p 377-380

Avail: NTIS HC A17/MF A01 CSCL 21E

A systematic approach to developing an engine monitoring system (EMS) is outlined. An extensive shopping list of EMS capabilities and benefits are included. A team approach to developing an EMS is emphasized with a description of the responsibilities of each team member. R.C.T.

N81-31218# General Electric Co., Cincinnati, Ohio. Aircraft Engines Business Group.
CF6-50 ENGINE EMISSIONS TESTING WITH TRAVERSE PROBE Final Report, May 1979 - Nov. 1980
T. F. Lyon and D. W. Bahr Jan. 1981 79 p refs
(Contract DOT-FA79NA-6010)
(AD-A102159; R81AEG213; FAA-CT-81-18) Avail: NTIS HC A05/MF A01 CSCL 21/5

The variation in emissions over the exhaust area of a General Electric CF6-50 model engine was investigated in order to determine the requirements for a representative sample. The emission measurements were made in a systematic pattern of 120 sample points using a traversing probe system. These data were used to develop detailed emission profiles at three power levels. At idle power, variations over the exhaust area are attributed to the particular fueling pattern used in current CF6-50 model engines. At higher power levels, where uniform fueling is employed, emission levels are more uniform and are characterized by a slightly peaked radial profile. Average values from the 120-point traverse were comapred with selected 12-point averages in the EPA prescribed cruciform pattern. Generally good agreement between the two averages was obtained. Author (GRA)

N81-31219# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Turbine Engine Div.
DETERMINATION OF AERODYNAMICALLY ADEQUATE FILLET GEOMETRY IN TURBOCOMPRESSOR BLADE ROWS Final Report, Apr. 1980 - Feb. 1981
Lucien L. DeBruge May 1981 45 p refs
(AF Proj. 2307)
(AD-A102170; AFWAL-TR-81-2020) Avail: NTIS HC A03/MF A01 CSCL 20/4

A method for determining the fillet radius likely to prevent separation of the corner flow at the intersection of an airfoil and a hub or shroud where no relative motion or gap is present is described. A computer program was written which, from the physical dimensions of the blading and the flow characteristics at the blading entrance and exit, calculates the corner boundary layer parameters allowing the prediction of the required fillet radius. An incompressible turbulent flow, with the influence of endwall boundary layer secondary flow on the development of the corner boundary layer, is considered. Author (GRA)

N81-31220# Williams Research Corp., Walled Lake, Mich.
CRUISE MISSILE ENGINE PROGRAM CONTRACT DATA REQUIREMENTS LIST SEQUENCE NUMBER 95. QUALIFICATION TEST REPORT. VOLUME 39: VIBRATION AND MISSION SIMULATION TESTING ON ENGINE 828. XF-107-WR-400 CRUISE MISSILE ENGINE
Laurence Toot Jun. 1981 257 p
(Contract N00019-78-C-0206)
(AD-A102257; WRC-79-106-39; CMEP-95-4120-Vol-39) Avail: NTIS HC A12/MF A01 CSCL 21/5

It is recommended that the testing completed with Engine 828 be accepted as evidence that the F107-WR-400 engine meets or exceeds the requirements for environmental vibration exposure and mission simulation testing as set forth in the PID Specification, 24235WR-9501A, and the Qualification Test Plan, CMEP 91-4043G, Report No. 78-145-8. GRA

N81-31222# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
PREVENTION OF CORROSION AND FATIGUE FAILURE OF HELICOPTER GAS TURBINE COMPRESSORS
R. J. H. Wanhill, H. J. Kolkman, A. J. A. Mom, and G. F. J. A. vanGestel Jun. 1980 13 p refs Presented at 6th European Rotorcraft and Powered Lift Aircraft Forum, 16-19 Sep., Bristol, England Sponsored by Directorate of Material Air, Royal Netherlands Air Force
(NLR-MP-80024-U) Avail: NTIS HC A02/MF A01

A failure analysis was performed on the compressor section of a helicopter gas turbine which disintegrated during normal flight. Corrosion pitting and fatigue due to acid rainfall were found to be the cause of the failure. Corrosion tests were carried out on rotor blades from the same type of compressor. Besides evaluation in the compressor rig the tests included exposure to neutral and acid salt spray environments which are conventionally used to determine corrosion resistance. Both uncoated blades, as used in service, and blades with commercially available protective coatings were tested. For the uncoated blades compressor rig testing proved to be severest and resulted in pitting corrosion most representative of that found for service components. The coatings afforded complete protection under all conditions. Author (ESA)

N81-31223 Stanford Univ., Calif.
A MODEL-FOLLOWING TECHNIQUE FOR INSENSITIVE AIRCRAFT CONTROL SYSTEMS Ph.D. Thesis
George Cooke Nield, IV 1981 101 p
Avail: Univ. Microfilms Order No. 8115817

The problem of designing multivariable control systems is addressed through the use of model-following methods. A number of different model following techniques are discussed, and their advantages and disadvantages are presented. It is shown the model-following theories can provide useful structural insight to the designer, and that they can help to integrate the methods of 'classical' and 'modern' control. A new design method is presented which, when implemented, uses model following and full-state feedback to keep the dominant roots of a system constant. Under favorable circumstances, it can do this even in the presence of arbitrarily large parameter uncertainties. The method has the attractive feature that the parameter-insensitivity and disturbance-rejection characteristics of the system can be selected independently from the no-disturbance, nominal-plant performance. Application is made to several aircraft flight control problems. Dissert. Abstr.

N81-31224*# Analytical Mechanics Associates, Inc., Hampton, Va.
TERMINAL AREA AUTOMATIC NAVIGATION, GUIDANCE, AND CONTROL 1: AUTOMATIC ROLLOUT, TURNOFF, AND TAXIS Final Report
Samuel Pines Aug. 1981 80 p refs
(Contract NAS1-15116)
(NASA-CR-3451; AMA-80-1) Avail: NTIS HC A05/MF A01 CSCL 17G

A study developed for the TCV B-737, designed to apply existing navigation aids plus magnetic leader cable signals and develop breaking and reverse thrust guidance laws to provide for rapid automated rollout, turnoff, and taxi to reduce runway occupation time for a wide variety of landing conditions for conventional commercial-type aircraft, is described. Closed loop guidance laws for braking and reverse thrust are derived for rollout, turnoff, and taxi, as functions of the landing speed, the desired taxi speed and the distance to go. Brake limitations for wet runway conditions and reverse thrust limitations are taken

into account to provide decision rules to avoid tire skid and to choose an alternate turnoff point, farther down the runway, to accommodate extreme landing conditions. Author

N81-31225# Royal Military Coll. of Science, Shrivenham (England). Dept. of Mathematics and Ballistics.
GENERALIZED DYNAMIC STABILITY FOR LINEARIZED YAWING MOTION
P. J. Richards and G. Pagan Oct. 1980 13 p refs
(RMCS-80002; BR78592) Avail: NTIS HC A02/MF A01

The generalized dynamic stability of spinning projectiles is studied by considering the homogeneous linearized equation of yawing motion. The solutions for constant and slowly varying coefficients are considered and it is shown that the possible yawing behaviors may be bounded by an envelope of exponential form, where the base is the magnitude of the first maxima and the exponent is an integral function of the equation coefficients. A suitable transformation is used to show that a similar bound may be obtained even if the coefficients are general functions. In many situations these bounds may supply the information a designer requires about the performance of a projectile.
Author (ESA)

N81-31226# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aeroelastik.
AEROELASTIC BUFFETING PREDICTION TECHNIQUES: A GENERAL REVIEW
Hans Foersching Apr. 1981 54 p refs
(DFVLR-FB-81-15) Avail: NTIS HC A04/MF A01

Analytical techniques for the prediction of the aerolastic buffeting behavior of flexible aircraft are described. The basic characteristics of separated-flow unsteady airloads as they relate to the aeroelastic buffet problem are briefly outlined. The problem of formulating appropriately the various types of regular or irregular buffeting oscillations is treated, and the corresponding mathematical physical models proposed and applied presently are reviewed. The problem of acquisition and conversion of wind tunnel model data to form full scale generalized aerodynamic buffet forcing functions and motion-induced airload terms is discussed in some detail. Author (ESA)

N81-31229*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AEROELASTIC INSTABILITY STOPPERS FOR WIND-TUNNEL MODELS Patent Application
Robert V. Doggett, Jr. and Rodney H. Ricketts, inventors (to NASA) Filed 17 Jun. 1981 11 p
(NASA-Case-LAR-12720-1; US-Patent-Appl-SN-274706) Avail: NTIS HC A02/MF A01 CSCL 14B

A mechanism for diverting the flow in a wind tunnel from the wing of a tested model is described. The wing is mounted on the wall of a tunnel. A diverter plate is pivotally mounted on the tunnel wall ahead of the model. An actuator fixed to the tunnel is pivotably connected to the diverter plate, by plunger. When the model is about to become unstable during the test the actuator moves the diverter plate from the tunnel wall to divert flow about the wing and change the effective sweep angle thereof maintaining stable model conditions. The diverter plate is then retracted to enable normal flow. NASA

N81-31230*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AEROELASTIC INSTABILITY STOPPERS FOR WIND-TUNNEL MODELS Patent Application
Robert V. Doggett, Jr. and Rodney H. Ricketts, inventors (to NASA) Filed 17 Jun. 1981 10 p
(NASA-Case-LAR-12458-1; US-Patent-Appl-SN-274705) Avail: NTIS HC A02/MF A01 CSCL 14B

A mechanism for constraining models or sections thereof, was wind tunnel tested, deployed at the onset of aeroelastic instability, to forestall destructive vibrations in the model is described. The mechanism includes a pair of arms pivoted to the tunnel wall and straddling the model. Rollers on the ends of the arms contact the model, and are pulled together against the model by a spring stretched between the arms. An actuator mechanism swings the arms into place and back as desired.
NASA

N81-31231# Committee on Commerce, Science, and Transportation (U. S. Senate).
AIRPORT AND AIRWAY SYSTEM DEVELOPMENT ACT OF 1981
Washington GPO 1981 280 p Hearings on S. 508 before the Subcomm. on Aviation of the Comm. on Com., Sci., and Transportation, 97th Congr., 1st Sess., 24-25 Feb. 1981
(GPO-75-804) Avail: Subcommittee on Aviation

Legislation intended to provide for the improvement of the nation's airport and airway system is addressed. Airport development in the areas of facilities and equipment and research, engineering, and development is discussed. Safety factors are emphasized. Programs and policies which will increase the productivity of the nation, reduce government participation and involvement in regulatory matters, improve aviation safety, and maintain a strong air transportation system are proposed. J.M.S.

N81-31232# Naval Training Equipment Center, Orlando, Fla.
THE EFFECTS OF VARIOUS FIDELITY FACTORS ON SIMULATED HELICOPTER HOVER Final Report, Mar. 1979 - Jun. 1980
G. L. Ricard, R. V. Parrish, B. R. Ashworth, and M. D. Wells Jan. 1981 72 p refs
(AD-A102028; NAVTRAEQUIPC-IH-321) Avail: NTIS HC A04/MF A01 CSCL 05/9

The effects of the cues of aircraft motion, of delays in a visual scene, and of movement of a ship model were examined by measuring pilots' ability to hover a simulated helicopter near a destroyer class ship. Fourteen Navy helicopter pilots were tested in a within subjects, factorial combination of fixed base, moving base, and g-seat conditions where delays of approximately 66 or 128 milliseconds existed in the simulator's visual display, and the pilots were to hover near a moving or stationary ship. In addition, an effort was made to determine the effect a head-up display of aircraft position had on the measures of control. Best performance was seen with the moving base simulation while poorest control was associated with the fixed-base conditions and in-between performance was measured under the g-seat conditions. The addition of the longer delay uniformly elevated scores, but movement of the ship model had little effect. Also performance was not affected by removal of the head-up display. A recommendation is made for the configuration of trainers for aircrews of marginally stable vehicles. This is that motion cuing is likely to be useful for flight regimes such as hover, and that currently platform technology is the recommended source of these cues. Author (GRA)

N81-31233# Naval Ship Research and Development Center, Annapolis, Md. Surface Ship Structures Div.
STRUCTURAL RESPONSE METHODS AND EVALUATION RESULTS FOR HELICOPTER LANDING DECKS ON 210- AND 270-FOOT USCCG CUTTERS Final Report, 1977 - 1980
M. O. Critchfield, J. L. Rodd, and W. H. Hay Jul. 1981 129 p refs
(Contract MIPR-Z-70099-6-65439)
(AD-A102420; DTNSRDC-81/009) Avail: NTIS HC A07/MF A01 CSCL 13/10

Since 1976, the David W. Taylor Naval Ship Research and Development Center has been assisting the U.S. Coast Guard in evaluating the strength of several helicopter landing deck configurations for existing 210-foot long cutters and for the new 270-foot cutters. These evaluations were performed based on a combined program of (a) analytical, (b) one-fifth-scale rigid vinyl model, and (c) full-scale investigations for several landing gear load conditions, including the main and tail wheels on the U.S. Navy LAMPS Helicopter. The analytical side of the program included: framing analyses using the finite-element method and other techniques; nonlinear, large-deflection analyses of the deck plating; and web bending analyses in the stiffeners. The web bending stresses referred to here are associated with local out-of-plane bending of the web due to a rotation of the joint between the stiffener web and the deck plating. These web stresses are distinct from those related to ordinary bending of the stiffener in the vertical plane. Web bending stresses in the stiffeners were first observed in full-scale tests on the 210-foot cutter STEADFAST and are not specifically addressed by current design procedures. A one-fifth-scale rigid vinyl model was used to validate the analytical procedures and also to investigate such considerations as load placement, orientation, and tire print geometry. GRA

N81-31234# Dayton Univ., Ohio. School of Engineering.
BIOCONAID SYSTEM (BIONIC CONTROL OF ACCELERA-

TION INDUCED DIMMING) Final Report
Dana B. Rogers, David L. Quam, Jack G. Crouch, and Andrew Higgins Jul. 1981. 110 p refs
(Contract F33615-77-C-0080; AF Proj. 6114)
(AD-A102510; AFHRL-TR-81-3) Avail: NTIS HC A06/MF A01 CSCL 05/9

The BIOCONAID System represents the development of a new technique for enhancing the fidelity of flight simulators during high acceleration maneuvers. This technique forces the simulator pilot into active participation and energy expenditure similar to the aircraft pilot undergoing actual accelerations. The system consists of an electromyographic (EMG) subsystem and the software implementation of four physiological models: Cardiovascular Model; G-Suit Model; Straining Model, and Visual Field Model. The EMG subsystem is required for signal processing of muscular straining signals used in the Straining Model. The EMG subsystem and all software except the Visual Field Model have been carefully checked-out to yield results consistent with experimental data and known physiology. Consequently, the BIOCONAID System has the potential of providing a very realistic simulation of visual dimming with straining during high accelerations. It is recommended that the system be implemented and evaluated in an Air Force simulator with experienced pilots.
Author (GRA)

N81-31235# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
FLIGHT SIMULATOR: USE OF SPACEGRAPH DISPLAY IN AN INSTRUCTOR/OPERATOR STATION Final Report
Lawrence D. Sher Jul. 1981 34 p
(Contract F33615-79-C-0013; AF Proj. 6114)
(AD-A101951; AFHRL-TR-80-60) Avail: NTIS HC A03/MF A01 CSCL 05/9

SpaceGraph is described as a new computer-driven display technology capable of showing space-filling images, i.e., images that are truly three-dimensional. This report details the findings on how this new technology can be used in, and in conjunction with, the Instructor/Operator Station (IOS) of a flight simulator. In current practice, the location, altitude, and flight attitude of a simulated aircraft are graphically shown to the instructor/operator on flat screens. This dimensionally-mismatched form of data presentation creates a greater workload on the instructor/operator who must integrate several flat presentations into a mental construct of performance in three-dimensional space. Such space-filling data should be shown with a space-filling display, now that one exists. Unexpectedly, student pilots were also able to use the display directly. As a training aid intermediate between 'flying' one's hands in the classroom and 'flying' the big simulators, it would appear to be a new kind of low-cost, part-task training vehicle. It offers the realism of computer-produced flight dynamics but with a view of the aircraft rather than out of the aircraft.
Author (GRA)

N81-31236# Civil Aeronautics Board, Washington, D.C.
AIRPORT ACTIVITY STATISTICS OF CERTIFICATED ROUTE AIR CARRIERS Annual Report
31 Dec. 1980 345 p Prepared jointly with FAA
(AD-A102355) Avail: NTIS HC A15/MF A01 CSCL 01/2

This report furnishes airport activity of the Certificated Route Air Carriers. Tabulated data includes: passenger enplanements, tons of enplaned freight, express, and mail. Both scheduled and non-scheduled service, and domestic and international operations are included. These data are shown by airport and carrier. Another table includes departures by airport, carrier and type of operation, and type of aircraft. GRA

N81-31238# Systems Control, Inc., West Palm Beach, Fla. Champlain Technology Industries Div.
NATIONAL ICING FACILITIES REQUIREMENTS INVESTIGATION Final Report, 16 Dec. 1980 - 1 May 1981
F. R. Taylor and R. J. Adams Jun. 1981 151 p refs
(Contract DTFA01-80-C-10080)
(AD-A102520; FAA-CT-81-35) Avail: NTIS HC A08/MF A01 CSCL 14/2

An analysis of National Icing Facilities requirements was performed at the request of the Federal Aviation Administration. This effort consisted of a five-month investigation to determine the scope and character of current and future icing facilities needs. This investigation included current aircraft needs as well as facilities that might be required for icing research, developing and certification testing through the year 2000. The information used for this study included all icing certification regulations for both fixed wing airplanes and rotorcraft. These regulatory requirements for icing certification were supplemented by a comprehensive analysis of current and future aircraft operational requirements. This independent facility requirements assessment was then compared to a previously published NASA review of icing facilities capabilities. The conclusion was reached that the need for an inventory of National Icing Facilities currently exists and will become intensified in the next decade. The technical characteristics of these facilities were described and it was recommended that a joint FAA/NASA/DOD Task Force be established to formulate and spearhead the development of a National Icing Facilities Program. Author (GRA)

N81-31320# Science Applications, Inc., Canoga Park, Calif. Combination Dynamics and Propulsion Technology Div.
COMBUSTION IN HIGH SPEED AIR FLOWS Interim Technical Report, Apr. 1981
W. N. Bragg, J. C. Chien, G. C. Cooper, R. B. Edelman, and P. T. Harsha Jun. 1981 72 p refs
(Contract F49620-80-C-0082; AF Proj. 2308)
(AD-A102336; SAI-81-030-CP; AFOSR-81-0594TR) Avail: NTIS HC A04/MF A01 CSCL 21/5

This report covers: (1) the application of a modular combustor model for the liquid fueled sudden expansion combustor configuration to the analysis of flame stability and the interpretation of combustor test data; (2) the extension of the modular model to the analysis of boron slurry fueled ramjet combustors; and (3) the development of analytical models of the ducted rocket combustor. The modular approach is demonstrated to be a useful tool for the analysis and interpretation of sudden-expansion combustor flame stabilization phenomena and to be of considerable utility in the analysis of combustor test data. Models for the combustion of boron particles are reviewed and put into a form suitable for incorporation in a modular model of a boron slurry fueled combustor. Particle tracking methods suitable for use in the context of a modular model formulation have been defined and developed for the required application. The approach required to provide an analytical model of the three-dimensional recirculating flow in a ducted rocket combustor has been defined and the development of an aerodynamic model has been initiated. GRA

N81-31398# Rolls-Royce Ltd., Derby (England).
A UNITED KINGDOM VIEW ON FUTURE FUELS
A. B. Wassell 1981 7 p refs
(PNR-90068) Avail: NTIS HC A02/MF A01

It is noted that the quality of aviation fuel is expected to deteriorate as the available liquid hydrocarbon fuels become increasingly scarce. The characteristics of the fuel which are the most important from engine operational considerations are discussed. A reduction in the fuel thermal stability is likely to be the most serious problem both for fuel control and distribution systems. The aromatic content increase will require a complete design reoptimization to avoid visibility of the exhaust plume. Higher nitrogen oxide emissions will require more complex combustion systems. The increasing carbon production will lead to shorter combustor life. Exhaust visibility problems experienced between startup and ground idle are also discussed. It is shown that no single parameter will be sufficient to define fuel quality, and that design philosophies will probably be required.
Author (ESA)

N81-31418*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MLS ANTENNA LOCATIONS FOR THE DEHAVILAND DASH 7 AIRCRAFT
Melvin C. Gilreath, Henry S. Earl, Jr., and Berkeley A. Langford, Jr. Jul. 1981 46 p refs
(NASA-TM-83195) Avail: NTIS HC A03/MF A01 CSCL 17B

Several proposed aircraft antenna locations were investigated to determine their potential for satisfying the microwave landing system antenna coverage requirements. The results of this investigation are presented and antenna locations are recommended for the deHavilland DASH 7 aircraft. R.C.T.

N81-31421*# Texas Univ. at Arlington. Applied Research Labs.
DEVELOPMENT OF A GROUND SIGNAL PROCESSOR FOR DIGITAL SYNTHETIC ARRAY RADAR DATA Final Report,

1 Jul. 1980 - 31 Mar. 1981
Carroll R. Griffin and James M. Estes 22 May 1981 57 p refs
(Contract NAS9-16104)
(NASA-CR-161074; ARL-TR-81-21) Avail: NTIS HC A04/MF A01 CSCL 17I

A modified APQ-102 sidelooking array radar (SLAR) in a B-57 aircraft test bed is used, with other optical and infrared sensors, in remote sensing of Earth surface features for various users at NASA Johnson Space Center. The video from the radar is normally recorded on photographic film and subsequently processed photographically into high resolution radar images. Using a high speed sampling (digitizing) system, the two receiver channels of cross-and co-polarized video are recorded on wideband magnetic tape along with radar and platform parameters. These data are subsequently reformatted and processed into digital synthetic aperture radar images with the image data available on magnetic tape for subsequent analysis by investigators. The system design and results obtained are described. Author

N81-31449# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AURAL COMMUNICATION IN AVIATION
K. E. Money, ed. Jun. 1981 184 p refs Presented at the Aerospace Med. Panel Specialist Meeting, Soesterberg, Netherlands, 30 Mar. - 2 Apr. 1981
(AGARD-CP-311; ISBN-92-835-1388-6) Avail: NTIS HC A09/MF A01

In modern military aircraft, it is essential that aircrew should be able to perceive and respond to audio information with minimum effort and highest reliability. However, the low quality of most airborne voice communications systems imposes such a high additional workload that messages are liable to misinterpretation or to being missed altogether. Reliable voice communication and the effective use of audio warnings are discussed. Hearing standards and conservation techniques are reported.

N81-31450# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
VOICE COMMUNICATION RESEARCH AND EVALUATION SYSTEM
Richard L. McKinley *In* AGARD Aural Commun. in Aviation Jun. 1981 7 p refs

Avail: NTIS HC A09/MF A01

The basic system is comprised of a multistation voice communication network consisting of the USAF standard aircraft intercommunication system, a standard A-19 diluter demand oxygen regulation system and an on line computer data collection and data analysis system that displays results in real time. The system is housed in a large reverberation chamber containing a programmable sound source capable of reproducing the spectrum and level of any AF operational noise environment. Standardized voice communication effectiveness test materials are used to assess the performance of any aspect of the total voice communication link, however, emphasis is usually placed upon the performance of the aircrew members. Examples of its application to voice communication problems are provided. T.M.

N81-31452# Naval Aerospace Medical Research Lab., Pensacola, Fla.
PHONOLOGICAL VARIANTS IN MEDIAL STOP CONSONANTS UNDER SIMULATED OPERATIONAL ENVIRONMENTS: IMPLICATIONS FOR VOICE ACTIVATED CONTROLS IN AIRCRAFT
James D. Mosko, Roger W. Remington, and Glenn R. Griffin *In* AGARD Aural Commun. in Aviation Jun. 1981 4 p refs

Avail: NTIS HC A09/MF A01

A motion disorientation test was used to determine potential effects on voice characteristics. Speech samples from 14 subjects were obtained under a STATIC (control) and a DYNAMIC (experimental) condition. The 10 subjects completing both phases of the test did not exhibit significant changes in fundamental frequency, word token duration, or voice level. Four subjects who voluntarily curtailed the DYNAMIC mode exhibited significant changes in the same acoustic characteristics. The implications of these results for automatic speech recognition are discussed. DOE

N81-31453# Naval Aerospace Medical Research Lab., Pensacola, Fla.
CLEAR SPEECH: A STRATEGEM FOR IMPROVING RADIO COMMUNICATIONS AND AUTOMATIC SPEECH RECOGNITION IN NOISE
James D. Mosko *In* AGARD Aural Commun. in Aviation Jun. 1981 6 p refs
Avail: NTIS HC A09/MF A01

The acoustic characteristics of conversational speech production and clear speech production were compared for three different talkers. Increases in fundamental frequency, word token duration, and voice level for the clear speech were obtained. These results are compared to the results of similar studies and implications for improved intelligibility of speech and automatic speech recognition are discussed. T.M.

N81-31454# Army Avionics Research and Development Activity, Fort Monmouth, N. J.
ELECTRONIC VOICE COMMUNICATIONS IMPROVEMENTS FOR ARMY AIRCRAFT
Mitchell S. Mayer and Arthur W. Lindburg *In* AGARD Aural Commun. in Aviation Jun. 1981 12 p refs

Avail: NTIS HC A09/MF A01

A communications system for Army aircraft, and two specifications which contain the test procedures required to accurately test and evaluate the various components of the communication system are decribed. The components of the system include: high impedance dc powered noise cancelling microphones; earphone elements designed and tested to have flat frequency response when inside the circumaural earcup of the hearing protective device; and intercoms which replace positive peak clipping with fast acting AGC circuits and expander/compander circuits for maximum output signal without distortion, even under conditions of extreme stress. T.M.

N81-31456# Royal Air Force Inst. of Aviation Medicine, Farnborough (England). Flight Skills Sect.
THE SPEED OF RESPONSE TO SYNTHESIZED VOICE MESSAGES
John L. Wheale *In* AGARD Aural Commun. in Aviation Jun. 1981 11 p refs
Avail: NTIS HC A09/MF A01

The effectiveness of synthesized cockpit voice warning messages using measures of reaction time (RT) was evaluated. Research has shown that voice messages are comparable to audio warnings and that synthesized voice messages are easily recognizable at low signal to noise ratios. Four different warning arrangements were used of which three had a Votrax voice component. The four warning systems represent possible warning combinations for transport aircraft. Subjects had to deal with simulated emergencies while performing a psychomotor tracking task and monitoring ATC messages. Thirty commercial pilots took part in the study. Overall the four warning systems were equally effective in terms of RT. However, voice messages had significantly slower RT's than audio warnings. Voice messages and illuminated legends caused significantly less disruption of ATC monitoring than audio warnings. Pilots also consistently cross checked voice and audio inputs with visual indicators. T.M.

N81-31458# Air Force Inst. of Aviation Medicine, Manching (West Germany).
VOICE WARNING SYSTEMS: SOME EXPERIMENTAL EVIDENCE CONCERNING APPLICATION
Michael Reinecke *In* AGARD Aural Commun. in Aviation Jun. 1981 8 p refs
Avail: NTIS HC A09/MF A01

Two experiments with voice warning systems (VWS), one in a helicopter UH-1D and the other one in a F 104 flight simulator are described. In the first experiment recognition times to identify simulated failures were measured in cruise and low level flights with 5 pilots. It was proved that voice warnings compared to light warnings do reduce recognition time. This is especially true during low level flight, and when only precise warning texts are used. In the second experiment the interaction of voice warnings and radio communication was investigated. Eleven pilots had to do a navigation flight and to react with correct emergency procedures when failures were introduced. Reaction times suggest that additional light warnings tend to slow down pilots reactions. The findings stress the possibility

that the pilot might become overloaded when voice warnings do occur while radio communication is going on. T.M.

N81-31459# Human Engineering Labs., Aberdeen Proving Ground, Md.
THE BACKGROUND AND BASES FOR THE PROPOSED MILITARY STANDARD ON ACOUSTICAL NOISE LIMITS IN HELICOPTERS
Georges R. Garinther and David C. Hodge *In* AGARD Aural Commun. in Aviation Jun. 1981 9 p refs

Avail: NTIS HC A09/MF A01

A design standard for interior noise of helicopters was prepared to provide the developer and user with realistic noise limits which consider hearing damage risk, speech intelligibility, mission profile, state-of-the-art in noise reduction, and helicopter weight. The levels selected meet the current hearing conservation limits of the Department of Defense and permit electrically aided sentence intelligibility of 98%. Helicopters below 20,000 pounds are treated separately from those above because of the strong positive relation between internal noise and vehicle gross weight. This standard defines the locations and flight conditions under which noise measurements shall be made for compliance. It also specifies the types of instrumentation and the test procedures to be used to collect interior noise level data. T.M.

N81-31462# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
COMPARATIVE INTELLIGIBILITY OF SPEECH MATERIALS PROCESSED BY STANDARD AIR FORCE VOICE COMMUNICATION SYSTEMS IN THE PRESENCE OF SIMULATED COCKPIT NOISE
Thomas J. Moore, Charles W. Nixon, and Richard L. McKinley *In* AGARD Aural Commun. in Aviation Jun. 1981 5 p refs

Avail: NTIS HC A09/MF A01

Among the systems evaluated was the ARC-164 radio which will serve as the reference system against which the performance of jam-resistant, secure systems developed in the immediate future will be compared. Relative differences found between male and female talkers under various levels of simulated cockpit noise are reported. T.M.

N81-31463# Institute of Aviation Medicine, Oslo (Norway).
SECOND LANGUAGE SPEECH COMPREHENSION IN NOISE: A HAZARD TO AVIATION SAFETY
Hans M. Borchgrevink *In* AGARD Aural Commun. in Aviation Jun. 1981 5 p refs

Avail: NTIS HC A09/MF A01

Simple Norwegian and English sentences were read by a bilingual adult, tape recorded and presented individually to bilingual adults with English or Norwegian as their first language and good command of the other. Each 65 dB sentence was first presented in so strong background USASI noise (75dB) that it could not be perceived, and was repeated with the noise level progressively reduced in 2 dB steps from presentation to presentation until the sentence was adequately repeated by the subject. The results demonstrated that for both groups the first (native) language sentences were correctly repeated after fewer presentations, that is at a lower signal-to-noise ratio, than the second language sentences. The difference between the first (native) language comprehension threshold and the second language comprehension threshold was statistically significant for both the Norwegian and the English subject groups. T.M.

N81-31464# Air Force Inst. of Aviation Medicine, Fuerstenfeldbruck (West Germany).
THE EFFECTS OF EAR PROTECTORS AND HEARING LOSSES ON SENTENCE INTELLIGIBILITY IN AIRCRAFT NOISE
G. R. Froehlich *In* AGARD Aural Commun. in Aviation Jun. 1981 2 p
Avail: NTIS HC A09/MF A01

Flight line personnel with hearing defects often complain that face-to-face speech communication in noise is considerably reduced when ear protectors are worn. Whether this could be confirmed or not was determined. An effective noise protecting flight helmet changes the flat aircraft cabin noise spectrum into a spectrum with predominance of lower frequencies. Whether the additional wearing of earplugs under the ear cups might improve speech perception was investigated. T.M.

N81-31467# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
VOICE COMMUNICATION CAPABILITY OF SELECTED INFLIGHT HEADGEAR DEVICES
Richard L. McKinley, Charles W. Nixon, and Thomas J. Moore *In* AGARD Aural Commun. in Aviation Jun. 1981 8 p

Avail: NTIS HC A09/MF A01

The voice communication effectiveness (MRT word intelligibility) of selected Air Force communications terminal equipment was evaluated in simulated operational noise environments. Analyses of the resulting data indicate: standard AF communications headsets H-133, HGU-26/P and H-157 performed in a manner consistent with their purposes with the H-133 providing the best communication, the HGU-26/P second and the H-157 third; percent correct intelligibility in the 115 dB noise condition was reduced as much as 15% for the H-133 and 50% for the H-157 over the ambient noise condition; communication performance varied over 5 to 10 percent when used with the AIC vs the AIC and RF radio; and the UK chemical defense hood provided a slightly better talking environment than the MBU-5/P and a worse listening environment than the HGU-26/P. T.M.

N81-31468# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
AN AUTOMATED MULTIPLE CHOICE INTELLIGIBILITY TESTING SYSTEM
R. L. Pratt *In* AGARD Aural Commun. in Aviation Jun. 1981 3 p ref
Avail: NTIS HC A09/MF A01

The test material used is the Modified Rhyme Test and the Clarke's Vowel Test (CVT). The MRT consists of groups of single syllable words which differ only in their initial or final consonant; for the CVT only the vowel is different. The relative performance of various noise cancelling microphones was compared by recording MRT and CVT word lists against a background of rotary wing noise provided using a prerecorded sample formed into a tape loop. The word lists were then replayed to subjects, seated in the same noise environment used for the recordings, through a communications headset with attenuation properties similar to helmets used in rotary wing aircraft. Subjects were required to select the word they thought they heard from a group of six words (five in the case of the CVT) presented on a Visual Display Unit (VDU). It is suggested that subjects' reaction time, when used in conjunction with the percentage correct score, may assist in discriminating between microphones of comparable performance. T.M.

N81-31470# Southampton Univ. (England). Inst. of Sound and Vibration Research.
AN ACTIVE NOISE REDUCTION SYSTEM FOR AIRCREW HELMETS
P. D. Wheeler and S. G. Halliday *In* AGARD Aural Commun. in Aviation Jun. 1981 8 p ref Sponsored in part by Ministry of Defense
Avail: NTIS HC A09/MF A01

A system was developed in which the acoustic noise field inside the ear defender is detected using a miniature microphone, and an antiphase signal is fed back to a communications telephone within the ear defender. The objectives for this development were to improve speech intelligibility, and to reduce noise exposure. In laboratory trials, a group of eighteen subjects, wearing an ANR-modified helmet, were exposed to an external noise field similar to that experienced by aircrew in a high performance strike aircraft. Comparisons of attenuation and speech intelligibility scores, with and without the ANR system in operation, were made. The modified helmet's performance was also compared to that of the standard helmet. In order to eliminate user controls, an adaptive control facility was added which optimises the degree of noise cancellation to compensate for variations in helmet fit between wearers. T.M.

N81-31473# Royal Aircraft Establishment, Farnborough (England). Human Engineering Div.
FLYING HELMET ATTENUATION, AND THE MEASUREMENT, WITH PARTICULAR REFERENCE TO THE Mk 4 HELMET
G. M. Rood *In* AGARD Aural Commun. in Aviation Jun. 1981 13 p refs
Avail: NTIS HC A09/MF A01

To predict the intelligibility of communication systems, it is necessary to be able to measure helmet attenuation accurately and repeatably, and it is this particular aspect which is highlighted. Some of the results from a comprehensive series of tests involving subjective and semiobjective measurement of the attenuation of noise by flying helmets are discussed. The analysis shows that the semiobjective method of ascertaining hearing protector or flying helmet attenuation, using miniature measuring microphones, is a viable alternative to the existing standard REAT methods, and has considerable advantages in providing more useful information in less time. Additionally, high correlations exist between laboratory and in-flight mesurements of attenuation, clearly indicating that laboratory measurements reproduce helmet attenuation actually found in the air. T.M.

N81-31474# Naval Avionics Center, Indianapolis, Ind. Applied Research Dept.

A MULTIPLEXED DIGITAL VOICE INTERCOMMUNICATIONS SYSTEM COMPATIBLE WITH FUTURE VOICE CONVERSION TECHNIQUES

Richard F. Bolt and Barry D. Sanderson *In* AGARD Aural Commun. in Aviation Jun. 1981 7 p refs

Avail: NTIS HC A09/MF A01

This system will be usable in a variety of aircraft. The individual stations are interchangeable from aircraft-to-aircraft, and the stations are comprised of plug-in modules that can be easily replaced by maintenance personnel. This modularity allows the system to be updated with future voice conversion techniques without rework or redesign. Currently available voice conversion techniques were evaluated for intelligibility in some military acoustic noise environments. A detailed description of the system is presented. T.M.

N81-31475# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario). Behavioral Sciences Div.

SIDETONE-LEVEL CONSIDERATIONS IN AIRCRAFT COMMUNICATION SYSTEMS

S. E. Forshaw *In* AGARD Aural Commun. in Aviation Jun. 1981 5 p refs

Avail: NTIS HC A09/MF A01

It is known that the loudness of an individual's speech is governed by two possibly related feedback phenomena: the 'sidetone-amplification effect', the tendency for a speaker to decrease his vocal effort when he hears his voice at an amplified level, and the 'Lombard effect', the tendency for a speaker to increase his vocal intensity in the presence of noise. The limited noise cancelling capabilities of current microphones are the major source of system amplified noise listeners ears. It may be possible to reduce the level of this source of noise, and hence increase a system's signal to noise ratio and speech intelligibility, by optimizing the level of a speaker's transmit sidetones to elicit an increase in his vocal output. T.M.

N81-31588# Royal Aircraft Establishment, Farnborough (England).

DIGITAL SPECTRAL ANALYSIS: A GUIDE BASED ON EXPERIENCE WITH AIRCRAFT VIBRATION

S. L. Buckingham Feb. 1981 58 p refs (RAE-TR-81014; RAE-FS-140; BR78387) Avail: NTIS HC A04/MF A01

The guide emphasizes a practical engineering understanding of the techniques based on experience gained in their application to the analysis of flight measurements of aircraft vibration in buffet. Quantization, aliasing, windowing, practical application of the fast Fourier transform, and the averaging of spectra are discussed in full, as are cross-spectral analysis and the coherence function. The practical difficulties encountered when the duration of the available data is severely limited, and the use of the coherence function as a tool in the interpretation of complicated responses are explained. The fundamental principles, and the inherent limitations of the techniques are relevant to any sphere of application. Author (ESA)

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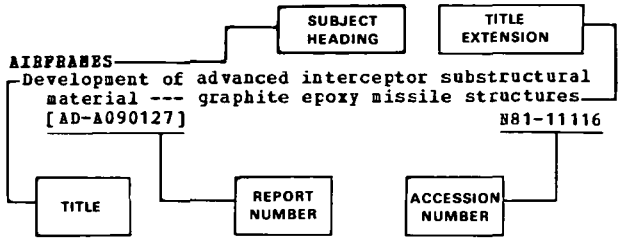

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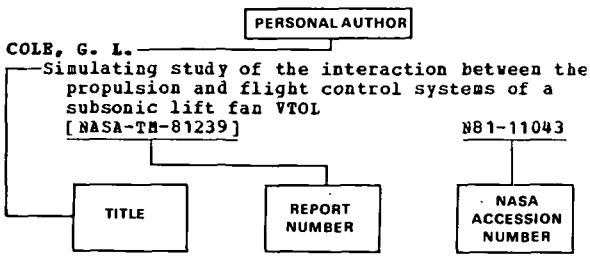

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